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Annual Report

of the

Department of Agriculture

1932

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Report of the Director of Agriculture.

Part I.—Agriculture in Nyasaland.

General.

Weather conditions.—From the point of view of crop growth, weather conditions during the 1931-32 season were on the whole better than the average but exception may be made in the case of small areas near Michiru, Fort Manning and Karonga. At the beginning of the season rainfall was everywhere above the average and early growth was adversely affected. During January, however, conditions were very good and crop recovery was rapid. Conditions continued to be favourable during the remainder of the season except in parts of the Northern Province where February rainfall was higher than normal. During the more important stages of growth of all crops, temperatures in general were slightly higher than normal, with the result that both food and cash crops ripened well and gave good yields.

Production and export.—The following table the figures of which are taken from the *Report on the External Trade of the Protectorate* for 1932 gives the amounts and values of agricultural produce and raw materials exported during the last three years.

	1930		1931		1932	
	Quantity	Value	Quantity	Value	Quantity	Value
		£		£		£
Capsicums and chillies	10,205 lb.	301	1,098 lb.	14	239 lb.	3
Coffee	952 cwt.	3,109	834 cwt.	1,988	789 cwt.	1,840
Maize and maize flour	349,500 lb.	646	311,452 lb.	558	5,400 lb.	9
Potatoes	2,284 lb.	12	34,150 lb.	182	97,136 lb.	511
Tobacco	12,934,914 lb.	484,738	10,690,581 lb.	400,897	15,032,035 lb.	565,576
Tea	1,939,756 lb.	56,543	1,963,452 lb.	49,129	2,573,871 lb.	42,898
Beeswax	157 cwt.	880	195 cwt.	1,092	170 cwt.	953
Cotton (lint)	1,696 tons	72,881	1,011 tons	37,729	935 tons	34,916
Cotton seed	1,620 tons	3,239	628 tons	1,257	1,138 tons	2,276
Fibre (sisal)	1,284 tons	29,607	242 tons	2,661	940 lb.	3
Groundnuts	1,216 lb.	7	1,100 lb.	6	—	—
Rubber	94,185 lb.	1,628	—	—	—	—
Strophanthus	8,146 lb.	1,222	10,581 lb.	1,587	7,601 lb.	1,140
Rice	—	—	2,176 lb.	10	6,201 lb.	28

Increases occurred in 1932 in the cases of tobacco, tea, potatoes, cotton seed and rice. In the case of tea it can be recorded with satisfaction that, while the amount consigned to the United Kingdom showed an increase of over half a million pounds or nearly 27 per cent. the exports to South Africa, Southern and Northern Rhodesia have also increased. The market for Nyasaland tea was thus widened during 1932, and it included small but increased quantities for Germany and Portuguese East Africa. Potato exports were confined to Portuguese East Africa and that country took a small quantity of rice, the rest going to Northern Rhodesia. Whereas exports of cotton seed increased in 1932, maize, maize flour and groundnuts which have found an outlet in Portuguese East Africa in recent years showed a large decline from 1931. Coffee exports also declined. South Africa took less Nyasaland coffee than in 1931 but, on the other hand, Southern Rhodesia increased her imports. Chillies and capsicums went to the United Kingdom, Northern Rhodesia, Tanganyika Territory and Portuguese East Africa, and beeswax to the United Kingdom and Germany as before. The tobacco export figures are striking and further reference is made to them in this report. Conditions did not permit of the resumption of tapping of rubber or the working of sisal estates.

The above figures should be studied in conjunction with the figures of the following two tables. The first table shows European acreages and production of the principal crops over the last three years.

	1930		1931		1932	
	Acres	Yields	Acres	Yields	Acres	Yields
Tea	9,686	1,904,000 lb.	11,414	2,193,296 lb.	12,596	2,699,984 lb.
Coffee	1,256	1,286 cwt.	1,542	1,175 cwt.	1,449	767 cwt.
Tobacco	17,481	6,508,768 lb.	13,482	4,168,528 lb.	14,314	6,252,288 lb.
Sisal	9,296	1,305 tons	9,304	153 tons	9,785	25 tons
Cotton	761	635 cwt.	225	159 cwt.	265	341 cwt.
Rubber	1,405	115,248 lb.	1,500	—	1,500	—

The second table shows the amounts sold and numbers of growers of the two native cash crops of importance.

	1930		1931		1932	
	No. of growers	Production	No. of growers	Production	No. of growers	Production
Cotton (seed cotton)	?	5,448 tons	?	2,477 tons	13,260	2,698 tons
Tobacco	48,419	4,233 tons	51,903	3,519 tons	53,044	5,904 tons

These tables show the unfortunate position of sisal and rubber which is reflected in the export figures and the increased production of tea and tobacco which led to increased exports during 1932. Economic conditions were as difficult and discouraging in the year under review as in the preceding year. Generally speaking, demand was so slack that a normal production was an over-production, and prices continued at levels which left little or no profit for producers and gave little or no encouragement to new crops. It is to the credit of local agriculturists, both European and native, that, despite small inducement, efforts to maintain and improve quality were continued during the year.

In certain directions, e.g., the tea industry, costs have been reduced to enable production to continue, and in others, particularly in cotton and tobacco, lower prices have been accepted by the growers and production continues, but healthy progress in agricultural production will not be possible until world conditions alter for the better and result in the improvement of purchasing power and prices in the markets and the stimulation of demand in general. Meanwhile efforts are being made to test new products so that, when conditions do improve, the country will be ready to respond to any encouragement that may be given.

Locusts.—Nyasaland was invaded by two species of locusts during 1932. In January North Nyasa was entered by a flying swarm of the migratory or hairy-chested locust. Action taken by the District Commissioner and the District Agricultural Officer coupled with the dying off of the swarm after egg-laying resulted in its eradication and the destruction of the hoppers. In March further swarms entered North Nyasa from Tanganyika Territory and Northern Rhodesia. Considerable damage was done to graminaceous crops and bananas, but the swarms left North Nyasa and entered Northern Rhodesia. From the end of July to early September occasional flying swarms were reported in North Nyasa, and in November serious invasion took place. Large swarms moved south from Tanganyika Territory on a line parallel to the lake shore and others crossed the lake from the eastern side. Egg-laying on a large scale was followed by the hatching of hoppers, but it seems that all these swarms remained in North Nyasa and did not penetrate further south.

In August and September further flying swarms of the migratory locust entered Nyasaland at the south-eastern end of Lake Nyasa. They travelled southwards through the Protectorate and passed into the Zambesi valley by mid-September. Later swarms which entered the Protectorate on the same line during September and October scattered and adopted three lines of movement, viz., due south along the line of the Shire River, a slightly more westerly direction, and a complete change of direction almost due west and also north-west. Other swarms were reported to have crossed the lake, and still others moved northwards on the western boundary in the vicinity of parallel 14° 13′S. Egg-laying occurred in widely-separated places to the south of Lake Nyasa and along the line and to the immediate west of the Shire River. The southern part of the Protectorate remained free of further invasion. In late November and early December hatching occurred in most of the areas in which eggs had been laid. The hopper bands were attacked by mechanical means and were much reduced in numbers, but mature winged individuals began to appear in early January 1933. Some locally-bred flying swarms thus developed in the Upper Shire valley, but the southern and central parts of the Protectorate escaped serious infestation during 1932. The position, however, was altered for the worse early in 1933 by invasions of the red-winged locust from Northern Rhodesia.

That the damage done by the flying swarms of the migratory locust was negligible may be attributed to the fact that at the time of their arrival no crops of importance were open to attack. Dry-weather gardens of maize suffered when flying swarms alighted on them or hoppers over-ran them, but so much jungle grass was available that damage was never excessive. If, however, locally-bred swarms are allowed to develop, the following season is likely to produce a different picture. The situation is being carefully watched. Five temporary European locust officers have been employed, destruction of hoppers has been urged, and attention has been given to the increased planting of crops which are less likely to be attacked than the common graminaceous food crops and also to the encouragement of certain short-aged food plants which are not ordinarily cultivated.

Bushfires.—Following the report of the Bush Fires Committee, a new ordinance dealing with the control and prevention of bush fires, known as the Bush Fires Ordinance 1932, was passed into law and was applied to the whole Protectorate. Thus progress was made towards the control of a harmful practice. The next step is the formation of District Fire Boards which will fix dates year by year after which bush burning in each district will be prohibited, the purpose being to encourage early in place of late burning, but it is likely to be postponed for a year at least on the ground that in 1933 late rather than early burning is to be encouraged as an anti-locust measure.

Subsidies.—No tobacco or other subsidies were given by Government in 1932, but the remission of a percentage of agricultural rents was continued.

Board of Agriculture.—An advisory body with the title Board of Agriculture was constituted in December 1932. Members were nominated by the unofficial members of the Legislative Council, the Convention of Associations, the Chamber of Commerce, the Agricultural Society, the Nyasaland Tobacco Association, the Nyasaland Native Tobacco Exporters' Association, the Native Tobacco Board, the Tea Research Association, the British Cotton Growing Association, the Empire Cotton Growing Corporation, the Zomba and Mlanje Planters' Associations, the Ncheu, Cholo and Dedza Settlers' Associations, and the North Nyasa Residents' Association. Official members included the Provincial Commissioners, the Conservator of Forests, the Chief Veterinary Officer, the Assistant Director of Agriculture and the Director of Agriculture, the last-named being chairman of the board.

The inaugural meeting of the board on December 7 was addressed by His Excellency the Governor. At the same meeting the board appointed two committees, one to consider the question of alternative crops and the other to consider the bearing of certain native agricultural practices and conditions on the well-being of the country. These committees began their work early in 1933.

Nyasaland Tobacco Association.—The department continued to work in harmony with the Tobacco Association and lent assistance in the matters of new markets for flue-cured leaf, classification of leaf in the customs returns of the United Kingdom and local type classification of

leaf. The last matter is of great importance and, in conjunction with manuring and soil conservation, has been taken up by a committee of the association under the chairmanship of the Assistant Director of Agriculture.

Nyasaland Native Tobacco Exporters' Association.—The association continued to invite the writer to its meetings, and its members were very helpful in the discussion of various questions affecting the native tobacco industry, for example, the deduction of an average in buying in the Northern Province, the scheduling of the Dedza area under the Tobacco Ordinance, the leasing of buying booths, tobacco beetle, the control of seed issue in the Southern Province, and a uniform opening date for buying.

Soil conference at Amani.—A conference of East African soil chemists met at Amani in April, 1932, and came to useful decisions on mapping and soil survey work, soil classification and nomenclature, and laboratory methods. Owing to the illness of Capt. Hornby, it was unfortunately not possible for Nyasaland to be represented at the conference.

Ottawa Conference.—As a result of the Ottawa Conference in July, preferences have been continued or given by the United Kingdom and other parts of the Empire to products in which Nyasaland is interested. It is unfortunate that, even with the help of certain preferences, world prices have not encouraged development of production, but the results of the conference have had a bearing on matters of policy and will have greater significance as world conditions enable Nyasaland producers to extend their operations.

Colonial Development Fund.—Money from this source has been made available and steps have been taken to provide new headquarters and laboratories in Zomba, to improve the equipment of Zomba and Port Herald Experimental Stations, and to open new stations in Mlanje (for tea work), in Lilongwe (for tobacco and native agriculture) and in North Nyasa (for native agriculture).

Tobacco.

In January a three weeks' drought in the Northern Province did little harm, and rain at the end of the month improved prospects north of the Diampwe. Early in the season the Ncheu and Dedza districts and the Mudi and Bua valleys promised well, good flue-cured tobacco was seen in the Likangala and Mikalongwe areas, and the Southern Province dark-fired leaf was better than usual. Some ringspot and aphis were to be seen, but there was little cabbaging or mosaic. Good reports were continued over February. Rain in the Northern Province in March followed by good ripening weather in April and warm dry conditions in the Southern Province filled out the leaf and brought about a good crop.

The tobacco production of 1932 is given in the following table and the 1931 figures are given for comparison.

	1931		1932	
European-grown:				
Flue-cured	Separate figures not collected in 1931		3,549,168 lb.	
Fire-cured		4,168,528 lb.	2,317,840 lb.	6,252,288 lb.
Air-cured			385,280 lb.	
Native-grown:				
Fire-cured		7,883,139 lb.	...	13,225,490 lb.
		12,051,667 lb.	...	19,477,778 lb.

Two further tables give the 1931 and 1932 exports of tobacco classified under flue-cured, fire-cured and air-cured and divided into amounts and percentages of the total exports according to European and native origin.

	1931		1932		Increase or decrease
	Amount lb.	Value £	Amount lb.	Value £	lb.
Flue-cured ...	2,590,253	97,134	2,260,500	84,769	— 329,753
Fire-cured ...	7,952,873	298,233	12,655,092	474,566	+ 4,702,219
Air-cured ...	147,455	5,530	166,443	6,241	+ 18,988
	10,690,581	400,897	15,082,035	565,576	

European-grown ...	4,201,399 lb.	39.3 per cent.	5,881,994 lb.	39 per cent.
Native-grown ...	6,489,182 lb.	60.7 per cent.	9,200,041 lb.	61 per cent.
	10,690,581 lb.	100	15,082,035 lb.	100

These figures show an increase of production of approximately 40 per cent. in the case of European tobacco and 67 per cent. in the case of native tobacco, and an increase of export of approximately 40 per cent. in both cases. It is to be noted that, despite the increase of production, the exports of flue-cured leaf fell in 1932, and, while those of air-cured leaf increased by a little over 12 per cent. the exports of fire-cured leaf increased by 50 per cent.

European.—European tobacco acreages and yields are given by districts in annexure G. When in late 1931 the Department of Agriculture collected on behalf of the Nyasaland Tobacco Association statistics of proposed European tobacco acreages for the 1931-32 season, the total acreage was reported as 12,932. This figure would have been a decrease of 550 acres on the 1931 total of 13,482, but the official statistics for 1932 which were collected at the beginning of 1933 disclosed that the

European tobacco acreage was increased rather than decreased. The acreage under European tobacco in 1932 was actually 14,314, a figure which shows an increase of 832 acres over the 1931 figure. Of the above European production of 6,252,288 lb., 4,619,664 lb. was sold locally, 732,256 lb. was exported for sale out of Nyasaland, and 900,368 lb. remained on hand unsold or unsaleable. The details of the disposition of the European crop are given according to method of curing in the following table.

	Flue-cured	Fire-cured	Air-cured
	lb.	lb.	lb.
Sold locally ...	2,649,472	1,714,496	255,696
Exported direct	225,344	442,512	64,400
Left on hand ...	674,352	160,832	65,184
	3,549,168	2,317,840	385,280

and a further table gives a comparion of the 1932 disposition of the crop with that of 1931.

	1931	1932	Increase
	lb.	lb.	lb.
Sold locally ...	3,374,112	4,619,664	1,245,552
Exported direct	442,736	732,256	289,520
Left on hand ...	351,680	900,368	548,688
	4,168,528	6,252,288	

It is possible that the unexpected increase of acreage and production was brought about by the supposition that Britain's abandonment of the gold standard would increase the demand for Empire leaf, and it is true that the local purchases of European leaf were increased by a gratifying amount. Likewise, the direct exports for sale out of Nyasaland increased and, though the amount of leaf left on hand may seem excessive, it is probable that only a little over 150,000 lb. of sound leaf remains unsold. On the face of things, the industry seemed to have improved its position in 1932, and it was to be expected that, if it were in a healthy condition, it would continue the improvement with the 1932-33 season. It seems strange, then, that the 1932-33 European acreage should be reduced from 14,314 to 8,793 acres, the latter figure being derived from the official returns, and a reason for the reduction must be sought. It is to be found in the selective buying of local purchasers which has led to rationed production and in the fact that leaf exported direct to the United Kingdom does not meet, on the whole, with an encouraging reception.

Selective buying on the part of the largest local purchaser seems to indicate that only certain grades are required, and, with regard to the home market, the fact that there is a prejudice against Nyasaland leaf (flue-cured, in particular) which is said to be founded on the inability of brokers and manufacturers to be certain of regular supplies of the same article from season to season must be faced. The remedy for the present unhealthy state of affairs is clear. It lies in selective or organised growing and in selective or organised marketing. It is necessary for the industry to produce fixed types of bright and dark leaf of guaranteed grade and quality from season to season to control the quality and perhaps also the quantity of leaf sent to the United Kindom for sale.

With regard to growing, attention is required to soil conservation (only 7.2 per cent. of European tobacco land is protected against erosion by ridge-terracing) and treatment, to the choice of varieties to be grown with reference to soil types, and to correct manuring, with a view to fixing types, correlating them to conditions of soil and rainfall in definite areas and turning out a product of regular and reliable grade and quality. The Department of Agriculture has done in the past a certain amount of propaganda in these directions and the Nyasaland Tobacco Association appointed a sub-committee in 1931 to consider type classification, but a most important step has been taken in the recent formation of a committee of the association under the chairmanship of the Assistant Director of Agriculture which will take these matters up and will issue definite instructions in due course. The recommendations will be for the good of the industry and they will have a definite purpose and will have to be followed. A practical beginning in the direction of brights has been made in the present season, but it is necessary to extend operations to cover all European growing. In addition, there is room for an attack on the air-cured market.

With regard to organised marketing, it is suggested that European producers should form their own co-operative society and should also consider the advantages of Government inspection and grading of tobacco for export. The operations of a co-operative society need not interfere with the local selling of leaf or with any direct connection that any producer may have with home brokers or manufacturers; they would aim particularly at guaranteeing the grade and quality of leaf sent for sale on a competitive market and they could not fail to be of advantage to the industry as a whole. There is nothing new or original in the above suggestions. They have been put forward from time to time, but it seems that early action is now called for and they are recommended to the serious attention of the members of the Nyasaland Tobacco Association.

While the home consumption of Empire tobacco continued to increase in 1932, Nyasaland tobacco comprised just under 30 per cent. of the total Empire usings. This figure is a slight decrease on the figures of previous years. Clearances of Empire leaf for home consumption during 1932 were 36,970,053 lb. This amount equalled 21.68 per cent. of all clearances. The actual amount of Nyasaland tobacco delivered for home consumption and export was 11,141,964 lb. The 1931 figure was 10,496,988 lb.

Native.—The following table gives the amounts of native-grown tobacco which were purchased in 1932 from Crown-land and private-estate growers in the various districts.

	Northern Province				Southern Province		
	Crown land		Private estates		Crown land		Private estates
	lb.		lb.		lb.		lb.
Lilongwe ...	4,650,429	...	1,337,577	... Mlanje ...	787,773	...	—
Dowa ...	2,312,887	...	387,515	... Cholo ...	76,463	...	33,798
Kota Kota ...	509,295	...	—	... Blantyre ...	330,271	...	108,562
Dedza ...	779,491	...	—	... Chiradzulu	493,890	...	325,870
Fort Manning	101,277	..	160,878	... Zomba ...	197,500	...	361,571
Ncheu ...	202,588	...	317	... Upper Shire	67,528	...	—
	8,555,977	...	1,886,287	...	1,953,425	...	829,801

The total Crown-land yield was 10,509,402 lb., an increase of 4,052,728 lb. on the 1931 figure. At the beginning of the season, buyers indicated that they would require increased quantities of leaf and an effort was therefore made to induce Crown-land growers to increase slightly the size of their gardens, due regard being paid to the needs of food crops. In addition, 1932 proved to be a good year for tobacco. The quality of the crop was good and all the tobacco was bought from the growers. Prices declined, however, and the 1931 average of 3¼d. per lb. was brought down to 2-2½d. per lb. It is estimated that the sum paid to Crown-land growers was over £90,000 and to private-estate growers about £24,363.

The numbers of registered Crown-land growers were 38,024 in the Northern Province and 5,767 in the Southern Province. The corresponding figures for the previous season were 32,153 and 10,708. There was therefore an increase of 5,871 Crown-land growers in the Northern Province and a decrease of 4,941 in the Southern Province. On private estates the numbers of growers were 3,939 in the Northern Province and 5,314 in the Southern Province. The Northern Province grower produced an average of 249 lb. of leaf for which he received £2, 1s. 6d. and the Southern Province grower an average of 251 lb. for which he received £2, 12s. 3½d. The decrease of Southern Province Crown-land growers may have been due to disappointment with the 1931 crop and prices, but it is suspected that many Southern Province growers did not trouble to register and steps have therefore been taken to ensure that registration is made more complete in the 1932-33 season.

A table in annexure G shows the purchases of native tobacco and the distribution of growers by districts.

The Native Tobacco Board closed certain buying stations in the Northern Province, viz., Maunda, Lingadzi and Kalolo, and opened a new station at Likuni, the object of the re-arrangement being to place the markets to the best advantage with relation to concentration of growers. Steps were taken to schedule the Dedza district under the Tobacco Ordinance and to erect a new buying station on the Tiwi River. The Native Tobacco Board continued its intensive supervision of the Northern Province Crown-land growers and instituted supervision in the Southern Province. The demand for the crop was good; in fact, it was so good that the market is temporarily overstocked and the Native Tobacco Board has decided to curtail Crown-land dark-fired production in the 1932-33 season.

The following table gives the actual amounts of tobacco which were sold in the markets of the Native Tobacco Board in the Northern Province.

	lb.
Nathenje	1,330,641
Lombadzi	1,670,331
Mponela	1,597,393
Malenga	509,295
Mudi	715,494
Likuni	1,649,467
	7,472,621

The restriction of native output in 1932-33 which is mentioned above is the result of a considered policy which endeavours to suit production to the state of the market. Despite the restriction every effort will be made to maintain and improve quality. At the same time, the Native Tobacco Board has embarked upon experimental work in the Northern Province. While the main object of the work will be the improvement of quality in native tobacco, the investigations will deal with the most economical method of maintaining good yields of dark tobacco and food crops, particular attention being paid to the soil treatment of the finger millets which play a large part in the native agriculture of the Northern Province. Trials will be made with the different forms of artificial nitrogenous fertilisers and with varying methods of applying organic matter while rotation systems will also be studied and soil conservation will be given attention.

Pests and diseases.—Special mention should be made of the fact that, thanks to a visit from Dr. H. H. Storey of the East African Agricultural Research Station, Amani, following on a visit he had made to Southern Rhodesia, it was established during the year that local tobacco disease known as *frenching* but more correctly called *cabbaging* or *leaf curl* was a virus disease which

was transmitted by a species of whitefly. Certain transmission experiments were undertaken by Dr. C. W. B. Arnold of the Imperial Tobacco Company and his co-operation was much appreciated. For the information and assistance of planters, an account of the leaf curl disease and of control measures was published in Bulletin No. 2 (New Series), and the opportunity was taken to include information on *mosaic* and *ringspot* which are also virus diseases.

Cotton.

European.—European production consisted of 341 cwt. of lint from 265 acres. Both the acreage and the production were increased from the previous year.

Native.—The production of seed cotton by districts in 1932 was as follows: Lower Shire 1,974 tons, Chikwawa 682 tons, Central Shire and Blantyre 42 tons. Because of the discouragement of growers caused by falling prices and reduction of the number of markets in 1931, seed issue for the 1932 crop was confined to Lower Shire, Chikwawa and the Lisungwe area of Central Shire and Blantyre. The amount of seed issued was only 187 tons, which was a fraction of the amount issued for the 1931 crop, and the Lower River growers were reduced in numbers by 40 per cent., but the actual crop was 2,698 tons of seed cotton, an amount which compared very well with the 1931 crop of 2,477 tons. The reasons for the very satisfactory crop were a good season, propaganda in favour of early planting and the more economical use of seed, and the replacement for the most part of *Nyasaland Upland* by *U4* seed. The crop yielded 5,067 bales of lint and the percentage of lint to seed cotton was 33⅓. Minimum and maximum yields of seed cotton in Lower Shire were calculated to be 400 lb. and 1,200 lb. per acre respectively and the average yield was probably between 600 and 700 lb. per acre. It is calculated that every pound of seed issued gave 14.5 lb. of seed cotton, a yield which is a great improvement on the 1930 and 1931 figures.

The crop was purchased by the British Cotton Growing Association at $\frac{5}{8}$d. per lb. for No. 1 grade and $\frac{3}{8}$d. per lb. for No. 2 at Port Herald and Chiromo, at $\frac{1}{2}$d. and $\frac{1}{4}$d. at Munga, Makwira, Mitoli, Nchinga, Kambalame and Chigaru, and at 7/16d., and $\frac{1}{4}$d. at Lisungwe. During the buying season prices were increased by $\frac{1}{8}$d. all round on two consecutive occasions and on a third occasion in response to improved market prices, but adverse market conditions caused the withdrawal of the advances and left the prices where they were at the beginning of the season.

On the whole the cotton season was more successful than was expected, and there are encouraging signs of an increased interest in the crop despite the low prices. It is anticipated that next year's crop in the Lower River area and Lisungwe will show a large increase of production and efforts are being made to revive cotton growing in the districts adjacent to the northern extension of the railway. Nyasaland is capable of increasing her cotton production by manifold and the best stimulus towards increased production would be improved prices. Unfortunately there is at the moment no promise of the home market price improvement which would put the industry firmly on its feet.

Export of cotton seed increased from 628 tons in 1931 to 1,138 tons in 1932, and uprooting dates were put forward on the whole by two weeks.

Tea.

In the early part of the year good yields were promised, and, although by March the rains were 5 inches below normal in Mlanje, a good season ensued. Much needed rain fell in October and the end of the year saw tea yielding well.

The 1932 acreage under tea was returned at 12,595, an increase of 1,181 acres over 1931. The Mlanje acreage was 8,417 and that of Cholo was 4,178. The acreage in plucking was 7,271, and the total yield was reported as 24,107 cwt. or 2,689,984 lb. The 1931 yield was 2,193,296 lb. so that production increased by nearly half a million pounds. Attention has already been drawn to the increase in tea exports in the year under review and to the extension of marketing, and it has been mentioned that the industry has reduced its costs of manufacture. The strict economies of 1931 continued to be exercised during 1932.

Two outstanding events of the year were visits from Dr. H. H. Storey and Dr. H. H. Mann. The former was concerned with the tea yellows problem and the latter with the industry in general. Dr. Storey lectured to the Tea Research Association on the cause and cure of tea yellows, and the results of the co-operative work of himself and Mr. Leach were made available in Bulletin No. 3. After a tour of inspection, Dr. Mann gave an account of his views and impressions to the members of the Tea Research Association and his lecture was published in Bulletin No. 4. His full report is awaited with great interest. Another matter of importance to tea growers is that of Bulletin No. 5 which, as the result of work performed by the Entomologist and Mycologist, sheds a new light on the causation of tea stem canker by proving that the real cause of the disease is the mosquito bug.

Arrangements were made during the year to send to the Imperial Institute samples of tea at certain times and intervals for examination and report. The samples were manufactured according to definite schedules which were varied at the discretion of the estate manager with a view to finding in what directions improvement in quality might be sought for. Useful data have been acquired and the work is being continued in 1933. The thanks of the industry are due to the Director of the Imperial Institute for his helpfulness in this matter. The Advisory Committee of the Tea Research Association continued to co-operate with the Department of Agriculture and the help of the members is gratefully acknowledged.

Funds having been made available by the Colonial Development Fund Committee, it was possible to make a beginning in 1932 with the opening up of land for a tea experimental station in the Mlanje district.

Coffee.

The total production of coffee in 1932 was 767 cwt. This figure compares badly with the 1,175 cwt. of the previous year, but the total acreage was also reduced from 1,542 to 1,449 acres and the area in bearing from 600 to 531 acres. Local sales accounted for 241 cwt. and 505 cwt. was said to be exported. According to the customs returns, however, the total exports for 1932 were 788 cwt., the countries to which the coffee was sent being United Kingdom, Southern Rhodesia, South Africa, Portuguese East Africa and Italy. The corresponding export figure for 1931 was 834 cwt.

Thrips made an appearance in April, and, while early flowering in October was good and flowering was general in November, white stem borer was serious in December. This pest threatens to be a limiting factor in coffee production in Nyasaland, and study of the conditions which determine its incidence is required. Plans have been made to embark on at least one aspect of this work in 1933, viz., the study of soil conditions with reference to lack of organic matter.

Sisal and Rubber.

Conditions did not allow of the resumption of operations on sisal estates and no tapping of rubber was done.

Other Agricultural Produce.

On European farms and estates, 1,444 acres were under maize, 86 under wheat, and 4,199 under legumes. Of the last mentioned, 3,658 acres were grown for green manuring, 479 for food and 62 for fodder. Oil-seeds totalled 101 acres and were practically all grown for food. Fruit trees occupied 221 acres and nut-bearing trees 12 acres, while the area of artificially established woodland amounted at the end of 1932 to 16,155 acres. Special mention is made below of tung oil.

Tung Oil.

The area under tung oil amounted to 51 acres. By the courtesy of the Conservator of Forests a small quantity of seed from the first bearing trees was made available for oil examination and report, and it is pleasing to be able to state that the Imperial Institute regarded the oil as of outstanding quality. A further sample of seed will be sent to the Imperial Institute in the current year, and it is hoped that the results of the examination will enable a definite policy of encouragement of the crop to be laid down. Due regard will be paid to recommendation of the best type of fruit for seed purposes and to the need for bud-grafting.

Native Food Crops.

The maize crop was very good on the whole and, yields being high, supplies were abundant. The first or main crop on the *dimba* lands of the Lower River area was of excellent amount and quality, and in many gardens it was reckoned that from 1 to 1¼ tons of seed per acre was obtained. The yield of the second crop was also good. The harvest of maize and millets was threatened by wet weather in North Nyasa, but the danger was averted and the food situation left little room for improvement. Yields of *mapira* (*Sorghum vulgare*) were variable but good on the whole. The average yield in the Lower River district was probably about 600 lb. per acre but in many gardens was higher than that figure. The stem-borer was less in evidence than last year and the efforts of the District Agricultural Officer to combat the stem-borer by persuading native growers to destroy ratooned plants were continued with some success. The *machewere* (*Pennisetum typhoideum*) crop was not so good as in 1931, a result which was largely due to fungus disease in the form of a smut and green ear mildew. *Mawere* (*Eleusine coracana*) was planted in the usual quantity but did not yield as well as in 1931. Other food crops such as beans, groundnuts, and sweet potatoes do not call for special mention, but it may be noted that efforts were made by the District Agricultural Officer in North Nyasa to popularise groundnuts and soya beans by free distribution of seed and that an increased groundnut crop in the Lower River area was entirely disposed of.

The lake-shore rice crop was good, that of North Nyasa being particularly heavy and of good quality. Continued attention was given to the North Nyasa crop by the District Agricultural Officer and his efforts bore fruit in improved seeding and cultivation, harvesting, grading and marketing. The Kaporo market was open to competitive buying but there was little competition owing to the depression. The amount marketed in North Nyasa was over 100 tons valued at about £700. It is likely that this amount would have been exceeded but for the fact that the locust menace caused growers to hold back larger food supplies than usual. The total lake-shore crop was estimated to amount to a little over 600 tons. Of this amount about 155 tons were sold to Government and about 120 tons to traders.

Investigation of native rice growing in the Ndindi Marsh area of the Port Herald district shows that seed stocks are mixed and that attention to time of harvesting, milling and grading is required. Observation plots have been laid down and mass-selection will be done later to provide material for experiment on the new *dimba* station in 1933-34.

In connection with selection work on rice in North Nyasa, samples of six rices were submitted to the Medical Research Council through the good offices of the Imperial Institute with a view to finding in their composition an explanation of native preference for certain varieties, but it was reported that the samples were so similar in composition that the slight differences between the varieties could not be regarded as of dietetic importance.

Part II.—Work of the Department of Agriculture.

District Work.—Details of district work are to be found in annexures A and B. By arrangement the department took over the Port Herald Experimental Station of the Empire Cotton Growing Corporation and carried on its work. In North Nyasa experimental work was carried on by Mr. Barker on a piece of land loaned without charge by the African Lakes Corporation, but this work had to be stopped in May when Mr. Barker was transferred to Port Herald to replace Mr. Lawrence who was due for home leave.

It was feared that, owing to an outbreak of trypanosomiasis among the experimental station cattle, little or no ploughing of native gardens in Lower Shire would be done in 1932, but it was found possible to plough a few later in the year at the request of the owners. The fees were paid in full. It is not possible greatly to extend this work but it is being continued. Experiments with communal grain stores were also continued, but no striking advance has been made despite the fact that storage has been proved to be feasible and the stores themselves have been improved. Increased interest, however, was taken in the improved strains of seed on the Port Herald Experimental Station. A variety of cassava introduced from Malaya is becoming very popular and exchanges of maize and *machewere* seed were made.

Spacing experiments with *mapira* at Port Herald showed that the densest plant populations gave the best yields and that one plant per hole gave a better yield than two plants per hole. This work will be continued along with manurial and time-of-planting trials with reference to attack of stem-borer. *Mapira* variety trials in North Nyasa showed that the local kind and a variety from South Nyasa known as *mikota* were superior in yielding power. In Port Herald a maize spacing experiment pointed to significantly heavier yields of both grain and straw from a 42-inch spacing with one plant per hole while a cultivation experiment in North Nyasa showed that the native method of planting at a spacing of 3 by 3 feet with an average of three plants per hole gave better results than single-plant stands spaced 4 feet by 15 inches in the ridge and that the local variety of maize gave a higher yield than *Potchefstroom Pearl.* Similarly, a cultivation experiment with finger millet (*Eleusine coracana*) in North Nyasa showed that a short-aged variety known as *kangumba* when broadcasted had superior yielding qualities to other two varieties whether the latter were broadcasted or transplanted and that *kangumba* itself responded better to broadcasting than to transplanting. Attention has also been given to the seed-treatment of Japanese Barnyard Millet (*Echinochloa frumentacea*) and *mapira* for the prevention of smut. Rice experiments in North Nyasa which were designed to test the broadcasting method of planting against the transplanting method failed to give significant results and will be repeated when staff is available for the work.

Plant introductions.—The following notes on recent plant introductions are of interest. Of medium and low shade plants for tea and coffee, *Gliricidia maculata*, *Derris robusta*, *D. microphylla* and *Leucena glauca* are doing well. *Cytisus alba* is subject to eel-worm and *Milletia oblata* is slow in growth. *Eriodendron anfraetuosum* (Java Kapok) and *Ceratonia siliqua* (locust bean) have made good growth. Of new varieties of pigeon pea from India and Hawaii, the very early kinds gave little seed and the Hawaiian varieties show more promise. *Phormium tenax* (New Zealand flax) also shows promise as a fibre plant in native hands. Ginger is doing well, but English grasses such as rye grass and cocksfoot and crested wheat grass from Canada show no promise. On the other hand, *Digitaria Penzii* is a promising fodder grass. Of green manures, hedge plants and cover crops, *Crotalaria spectabilis* was badly attacked by jassid but is now becoming acclimatized. *Crotalaria Brownei* and *C. juncea* varieties have been disappointing. Certain species of *Cassia*, *Clitoria* and *Desmodium* should make good hedge plants. *Dunbaria heynei*, *Pueraria phaseoloides*, *P. javanica* and *Centrosema pubescens* have been fairly successful but *Calopogonium mucunoides* is better than either of them. *Herman Yellow* soya bean is more attractive but shatters more easily than the acclimatized *O-too-tan* and *Biloxi.* Lupins and *Trifolum subterraneum* are not doing well, but *Medicago sativa* (*lucerne*) is improving with inoculation and liming. A variety of *Setaria italica* obtained from the United States of America is superior to the local types of Italian millet.

In addition to the above foreign introductions, the Zomba Experimental Station contains observation collections of the varieties of cereals grown by natives and also of types of legumes.

Chemistry and soils.—Efforts are continually being made to discover a workable classification of Nyasaland soils which will be of use to scientific bodies and agricultural workers in general. It is apparent that there is a much closer connection between climate and the composition of soil types than has appeared in the past. Errors in sampling have often masked this close connection, especially when dealing with soils in which movement of water during the rainy season is abnormal. Climatic soil types, then, if properly sampled can be characterized in various ways chief of which is the results of analysis of the colloid or clay fraction on which again the properties of many soils mainly depend.

These climatic soil types can be further examined and experimented with and their deficiencies can be correlated with the behaviour of many crops. The quality and yield can be improved by the results of these experiments which are of great importance in the future development of both our tea and tobacco industries.

The division of climatic soil types into series offers the best means towards a workable classification and moreover the names of these series may be extended to the various types of Nyasaland tobacco, the correct maintenance of which is of supreme importance to the industry.

The above is an outline of the close connection which must always exist between laboratory work and field work. The days have gone by when haphazard samples were taken from the field of the farmer and when extraction of certain compounds from such sample by dilute acid was supposed to show the fertility or manurial requirements. Much more work is doubtless required on various crops and their varieties, especially on the correct treatment in the field, but the conclusion of experiments which have statistical significance is encouraging and expenditure on such work for the good of agriculture in general, the only industry in Nyasaland, is not an extravagance.

Entomology.—A history of the 1932 locust invasion will be found in annexure D. Although the Entomologist's work was thrown out of gear by the attention devoted to the locusts and by the need for organising and supervising the efforts of natives and temporary locust officers, useful work on the insect pests of cover crops, fruit trees and tea was done. The relation of insect pests to permanent cover crops is of great importance. Mention has already been made of the new explanation of tea branch canker which has been advanced by Messrs. Leach and Smee, and special mention may be made of the coffee shade experiment which is described in annexure D. of the need for destruction of old tobacco plants which is mentioned in reference to cabbaging, and of the equally pressing need for seed-bed hygiene with reference to yellow stem-grub and greenfly.

Mycology.—Under *Tea* mention has already been made of the yellows disease and a new causation of stem canker. In annexure E there will be found an account of a tea seedling disease and of the extension of Mr. Leach's sulphur-deficiency work to other plants than tea and with special reference to plants used in native agriculture. Mr. Leach went on leave in September and he will return in 1933 to the work of opening the new tea experimental station in Mlanje in addition to his mycological duties.

Botanic Gardens, Zomba.—The reduction of the vote for upkeep necessitated strict economy and allowed only the continuation of the improvement work through cover crops, contour hedges and the application of Indore compost and cattle manure in small quantities. It was not possible to introduce any new plants in 1932.

Publications.—The issue of the new series of bulletins mentioned in last year's report was begun early in 1932.

The following bulletins were issued during the year.

No. 1. Tea Research in Nyasaland; advertising of Empire tea in the United Kingdom; tea imports into South Africa and the Rhodesias

No. 2. Virus diseases of tobacco in Nyasaland.

No. 3. Tea yellows disease.

No. 4. Tea growing in Nyasaland; tea possibilities of the area near Nkata Bay.

No. 5. Mosquito bug the cause of stem canker of tea.

Staff.—The following officers were on leave in 1932. Capt. A. J. W. Hornby, M.B.E., Assistant Director of Agriculture and Agricultural Chemist, from April 22 to November 2; Mr. R. Leach, Mycologist, from September 14 to December 31; Mr. E. Lawrence, District Agricultural Officer, from June 23 to December 31; Mr. J. A. A. Channer, Senior Clerk, from January 1 to June 1. Capt. C. Smee, M.C., Entomologist, acted as Assistant Director of Agriculture from April 21 to to November 4.

Dr. I. W. M. Armstrong Black was appointed Assistant Agricultural Chemist on August 4 and arrived at Beira on September 6.

Financial.—The following table gives an analysis of the cost of the operations of the Department of Agriculture during the year under review.

	Approved estimate	Amount spent
PERSONAL EMOLUMENTS:		
	£	£ s. d.
European staff	5,477	5,523 8 10
Native staff	650	544 11 0
	6,127	6,067 19 10
OTHER CHARGES:		
Transport	733	449 10 2
Travelling	130	34 7 11
Passages	564	640 14 9
Experimental Work	250	225 4 9
Distribution of Cotton Seed	100	193 5 2
Botanic Gardens	45	44 13 5
Contribution to Agricultural Shows ...	120	120 0 0
Treatment of Plant Diseases, Tobacco Pests, etc...	150	59 17 9
Library	100	76 0 9
Tools and Equipment	250	216 6 7
Seeds and Plants	150	21 8 1
Incidentals	55	23 8 6
Uniforms	48	18 0 0
Native Cotton Industry	100	90 0 0
Contribution towards upkeep of experimental stations E.C.G.C.	500	500 0 0
Transport (E.C.G.C.)	300	196 9 10
Typewriters	25	25 1 8
Anti-Locust Campaign	—	215 3 0
	3,620	3,149 12 4
	9,747	9,217 12 2

Part III.—Work of the Empire Cotton Growing Corporation.

In annexure F will be found the introductory note and summary written by the Cotton Specialist for the full reports by Messrs. Hoyle, Miller and Barker on the work of the Domira Bay, Makwapala and Port Herald Experimental Stations respectively. Mr. Ducker's summary is a clear and concise outline of the activities of the Corporation, and anyone who is interested may obtain the full reports on loan from the Department of Agriculture. They have been published as usual by the Empire Cotton Growing Corporation in a separate volume.

Attention may be drawn to the consummation of Mr. Ducker's plans for concentration of his work at Domira Bay which has already become the headquarters of the Empire Cotton Growing Corporation in Nyasaland. The Port Herald station was handed over to the Department of Agriculture at the beginning of 1932 and Makwapala will be handed over likewise in 1934 or at the beginning of 1935. The eventual concentration of staff at Domira Bay will allow of full attention to the most important work of breeding and selection, and there is no doubt that time will prove the wisdom of Mr. Ducker's move into an area which is both rich and capable of development as a cotton-producing territory.

The cost to the Government of its 1932 contribution to the work of the Corporation in Nyasaland was £697 of which £500 was devoted to the upkeep of experimental stations and £197 to travelling.

Part IV.—Native Tobacco Board.

Certain activities of the board have been mentioned under *Tobacco*. No new appointments were made to the staff of the board and no resignations took place. Leave was taken by Mr. J. W. Pryor from September 14 to December 31, Mr. R. E. Wilbraham from January 1 to January 13, Mr. R. E. Clegg, M.B.E. from October 12 to December 31, and Mr. R. M. Antill, M.C. from July 28 to December 31.

The members of the board for the full year were: Director of Agriculture (Chairman), the Treasurer, Capt. A. J. W. Hornby, M.B.E., and the Honourable Mr. W. Tait-Bowie, O.B.E. The Secretary for Native Affairs served on the board until October, and the unofficial representation was increased by the addition of Mr. A. F. Barron in December.

Among the many matters before the board, the chief were the extension of the supervised area of the Northern Province and the establishment of a new buying station in Dedza, the control of seed supply in the Southern Province, production policy for the season 1932-33, registration of growers and experimental work in the Northern Province. The board also published in the vernacular a small handbook of instructions for growers which was written by Mr. Antill. Perhaps the most important of these matters is the institution of experimental work at Likuni for the conduct of which Mr. Antill has been removed from his field duties. It is hoped that his work will include in time the supervision of the dissemination among native growers of experimental results, and with the aid of trained capitaos, the general supervision of matters of conservation of soil and of fertility and the encouragement of forestry. It had been suggested that the board should be abolished and its staff should be absorbed into the Department of Agriculture, but the Secretary of State for the Colonies decided in favour of the retention of the separate identity of the board.

Analysis of the cost of the operations of the board will be found in annexure H.

The writer wishes to express his appreciation of the work of the British Cotton Growing Association and the Empire Cotton Growing Corporation and to thank their staffs, the members of the staff of the Department of Agriculture and the members and staff of the Native Tobacco Board for their work and general helpfulness.

W. Small,
Director of Agriculture.

Report of the District Agricultural Officer, Lower Shire and Chikwawa.

PART I.

This report deals with the first five months only of 1932, the writer proceeding on leave on June 23. The services of Messrs. G. M. Boby and F. Stephens were retained by the department for cotton seed distribution during January, February and March, and the writer wishes to again place on record his very sincere thanks and appreciation for the readily given assistance and advice that he has received from them both at all times. His thanks are also due to the various District Commissioners for their generous assistance.

Work in the district was carried on on lines similar to those of last year and alterations or modifications are mentioned under the relative headings.

Meteorological.

Well distributed and adequate rains fell during the first two and half months of the year and native food crops and cotton germinated well and made good early growth. During the end of March a hot dry spell seriously retarded growth in the late cotton gardens and rain in early April was succeeded by another short droughty period which not only killed off some of the most backward cotton plants but also began to affect the *mapira (Sorghum vulgare)* crop which was by then in hand. Unexpected but very welcome rains in May, usually a dry month, saved the cotton crop and improved the *mapira* yield considerably. Sweet potato cuttings were planted out in the *dimbas* after these May rains and by the end of the month the crop was well established.

The total seasonal rainfall from November 1931 to the end of May was 25.12 inches; the total for the first five months of this year 19.72 inches. Some more rain may be expected in June, July or August.

From table 3 it will be seen that the monthly rainfall totals were fairly consistent throughout the Lower River and the remarks already made apply equally well to the Chikwawa and Chiromo areas. In all three areas the maize crop was very good, in many gardens excellent.

Monthly meteorological details from Chiromo and Chikwawa were supplied by Messrs. G. M. Boby and F. Stephens. These details will be found in the form of three tables at the end of this report.

Cotton.

Seed distribution.—The scheme, outlined in last year's report, for a complete change-over to *U4* seed throughout the Lower River was put into operation this year. 128 tons, 8 cwt. of No. 1 *U4* seed were available for issue at the Port Herald ginnery. It was proposed that 40 tons, 8 cwt. remain at Port Herald for issue there, 36 tons be sent to Chiromo, 35 tons to Makwiras and 17 tons to Mitoli. 89 tons were accordingly sent by rail to Chiromo and part of the 52 tons for Chikwawa had already been taken up by barges when it was decided that the supply of *U4* would be inadequate for the whole of the Lower River. The Chikwawa markets were therefore closed on January 20 and further transport of *U4* stopped. *Nyasaland Upland* seed from Chiromo was taken up to the Chikwawa stores, the barges bringing back *U4* seed on their return journey. Some 12 tons of *U4* seed had already been issued in Chikwawa and of the remaining 40 tons 13 were taken back to Port Herald and issued there, making a total issue of 53 tons, 8 cwt., 27 being added to the original 36 at Chiromo, making a total issue there of 63 tons. Some 58 tons of *Nyasaland Upland* seed were issued from the three markets of Mitoli, Maperera and Makwira making a total issue there, with the 12 tons of *U4* already given out, of 70 tons.

Seed was issued from five centres only—Port Herald and Chiromo ginneries, Makwiras, Mitoli and Maperera, and the stores were opened on January 1 and closed on March 15. Seed was given out in 15 lb. issues and each applicant had to produce his 1931 tax paper, the back of which was marked. Applications for more seed were frequent and genuine needs were attended to. Gardens of large growers were measured and seed allowed according to acreage. Seed was also issued on production of hut tax exemption papers and as far as possible hut tax defaulters and youngsters, not of age to be liable for hut tax, were given seed.

Great care was taken at Chikwawa, Chiromo and Port Herald to distribute the seed as fairly as possible and it is believed that every cotton grower on the Lower River who really wanted seed had an adequate allowance. No native in 1932 was able to advance shortage of seed as an excuse for not planting a cotton garden or for limiting the size of his garden assuming that he used his seed carefully and planted properly. Natives who were too lazy to come in for seed before March 15 and natives who planted in the old fashion (a handful of seed to a hole) undoubtedly had a smaller crop this year. It may be safely said that the early closing date eliminated the lazy grower and that the restricted issues of seed forced better methods of planting upon the majority of growers.

Total seed issues were as follows:—

CHIKWAWA (Makwiras, Maperera and Mitoli)				lb.
1st issues	...	6,607 applicants received	...	113,840
2nd ,,	...	2,538 do do	...	39,122
3rd ,,	...	333 do do	...	4,996
4th ,,	...	12 do do	...	180
				158,138

6,607 applicants received 158,138 lb. of seed. The average issue per applicant was 24 lb.

CHIROMO				lb.
1st issues ...	...	6,242 applicants received	...	93,630
2nd ,, ...	...	3,335 do do	...	50,025
				143,655
Larger growers	...	60 do do	...	6,748
				150,403

6,302 applicants received 150,403 lb. of seed. The average issue was $23\frac{3}{4}$ lb.

PORT HERALD.

				lb.
1st issues ...	5,197	... applicants received	...	92,640
Larger growers	58	... do do	...	7,639
				100,279

5,255 applicants received 100,279 lb. of seed. The average issue was $19\frac{3}{4}$ lb.

SUMMARY

						lb.
Chikwawa	...	6,607	...	applicants received	...	158,138
Chiromo	...	6,302	...	do do	...	150,403
Port Herald	...	5,255	...	do do	...	100,279
	...	18,164	...	do do	...	408,820

The average issue per applicant was $22\frac{1}{2}$ lb.

In former years the number of issues and applicants for seed has been no guide to the number of gardens or possible production. This year it is belived that the number of applicants for seed will be a fair indication of the number of cotton gardens.

A comparison between the weights of seed issued in the past three years may be of interest.

			Cotton seed issued lb.		No. of cotton gardens.
1930	...	...	1,371,474	...	27,495
1931	...	...	1,466,868	...	22,531
1932	...	...	408,820	...	13,102

Many natives again left planting until too late and only the unexpected May rains saved them from complete failure. In the Port Herald and Chiromo areas the need for early planting on the light *mpala* land was again evident. When the writer left the district the gardens planted in January and early February were ready for picking and gave every promise of being able to produce a second crop with the mid-season rains. Late-planted gardens (and these were far too common in the Port Herald district where the enforced late planting of the Ndindi Marsh people seems to influence the *mpala* land people as well) had made hardly any growth at all and had not commenced flowering; but for the rains in May all this late-planted cotton would have died. *Dimba* land cotton was flowering heavily. There was every promise of a good crop and the *U4* seed seemed to be doing well under native conditions.

A few "reversions" and off-types had been seen but on the whole the plants were very uniform. Stands were good and seed restriction had definitely discouraged, in the majority of gardens, the very heavy seed rate of 1931.

There is no doubt that the change of seed on the Lower River was long overdue, apart from any superiority of *U4* over *Nyasaland Upland* as a better type or heavier cropper. A great deal of the old *Nyasaland Upland* seed was not viable and natives were justified in using a high seed rate. A further reason for the better stands this year was that seed was only issued from the ginneries and no deterioration took place through lying in badly built village stores.

Continual propaganda work is needed in the future to encourage the native to plant early on his *mpala* land gardens. Early planting followed by an early drought can be followed in its turn by another planting. When a late drought follows early planting the crop is well established and is not affected, but when late planting is followed by a late drought the result is disastrous. Bollworm attack is serious in some years but it is better to have a crop attacked by bollworm

than no crop at all. There is the further point that the native cultivator, not too swift in his processes, begins to prepare his garden when he means to plant. If he can be told repeatedly to plant in January he will begin to prepare his garden and fetch his seed in January. The more energetic native will actually plant in January, the average native in February, and the lazy native in March. Only the most energetic on the Lower River will plant within a fortnight of a date given, even when he understands what a date is and is convinced that the date is the right one. A lag of at least a month must be allowed always, during which the garden is prepared and the seed fetched from the store. Until the Lower River native is considerably better educated, all advice must be very carefully thought out and all probable and possible allowances made for native construction, misconstruction, misinterpretation and inherent inability to do a thing without first thinking it over and talking about it for at least a fortnight.

Native Food Crops.

Last year the *mapira* (*Sorghum vulgare*) crop failed throughout the Lower River but *machewere* (*Pennisetum typhoideum*) yielded well. This year the positions were reversed although the failure of the *machewere* crop was not so complete as that of the *mapira* last year. During the latter half of January, the food gardens in certain areas suffered heavily from drought and some of the millets succumbed. Straw was very short in the survivors and heads were smaller, but far more serious than this as far as the *machewere* crop was concerned was the widespread attack of fungous diseases which became increasingly evident as the heads began to form in March. A smut and a green ear mildew took heavy toll in the *machewere* gardens and in many areas there was barely enough grain for food and beer until the *mapira* crop was ready. Bird-scaring as usual lasted for a fortnight or so, and then, as parental authority relaxed through a surfeit of beer, the gardens were abandoned to the birds. *Mapira* was again attacked by the stem borer, *Chilo* sp., but, except in the few areas which suffered from the January drought, yielded well; in many places the crop was excellent. Throughout the Lower River the first and main maize crop was good, the second well up to average. As with the millets maize gardens in certain areas were affected by the drought late in January but in the Ndindi March and in the *madimba* along the east bank of the Shire River north of Chiromo the yield was excellent. Rice gave an exceptionally good yield this year and of the minor crops green gram (*Phaseolus mungo*), Vigna beans and sesamum did well.

Late *dimba* crops, maize, sweet potatoes and pulses, are in most cases well established and promise to yield well.

There is no reason to expect anything more than the usual food shortage in December and January if the late *dimba* crops fulfil their promise, but when the writer left the district there was certainly no great surplus of food to be seen and it is hoped that petty traders were not allowed to trade and speculate in native grain. It looked as though they would have to be allowed to handle a large groundnut crop which Lower River natives had been encouraged to grow.

The writer's thanks are due to Captain Smee and Mr. Leach for their kindness in identifying various insect and fungous pests and for the advice and assistance they have given him.

Machewere (*Pennisetum typhoideum*).—The yield this year varied tremendously in different areas but on the whole was poor. The harvest was later than last year and the main cutting did not take place until the end of March, only a few of the very earliest heads being ready by January. It was impossible to estimate an average yield for the Lower River as some gardens gave hardly 50 lb. of grain to the acre and others up to 1,000 lb. Very few gave more than 600 lb. and the majority far less. A drought during the end of January and the usual bird ravages diminished the yield appreciably but the main losses were due to a smut (*Tolyposporium penicillariae*) and a green ear mildew (*Sclerospora graminicola*). Both were widely distributed but the former was responsible for the greatest damage and towards the end of April smutted heads were very common in every garden.

Mapira (*Sorghum vulgare*).—In most areas the yield was good; in others very variable. Harvesting commenced in earnest towards the end of May but green heads were being cut in April and some of the earlier types such as *kachiliwendi* and *khasikhisakhowa* were in head and flowering in March. The average yield was probably in the neighbourhood of some 600 lb. to the acre but in many gardens was higher. In the areas just north and south of Chiromo where the January drought did most damage the yield was considerably lower.

The two main pests of this crop on the Lower River appear to be the stem borer, *Chilo* sp., and the smut, *Sphacelotheca sorghi*, both of which were mentioned in last year's report. This year they were between them responsible for a loss of some 30 per cent. to 40 per cent. and it is difficult to say which of the two did the more harm. The insect was certainly less in evidence than last year, the fungus more. A third pest, a parasitic weed (witch weed, *Striga* sp.) is also responsible for a great diminution of the yield but it is at present impossible to estimate the actual amount of the loss. Observations made this year show *Striga* to have been very common in certain areas and very rare in others. It was only found on *Sorghum* spp., cultivated and wild, and on *Pennisetum purpureum*, *nsenjere* grass. It was never found on *machewere* nor on maize although it was found in gardens of mixed *machewere* and *mapira* (*Sorghum*). The only method of dealing with this weed at present seems to be that of hand pulling and natives are to be encouraged to rid their gardens of this pest next season as soon as it appears. The writer has not yet discovered any natives who realise that *Striga* is in any way harmful to their crop.

The propaganda work on the harm done by ratooning *mapira* seems to have had some effect in the district and very many natives did really make some effort to destroy all ratooned plants. It is impossible to say whether the absence of ratoons made any difference to the stem-borer attack but fortunately the natives themselves appear to think that it did and they will certainly be encouraged to continue the suppression of ratooned *mapira* every year. At present there does not seem to be any other way of controlling or preventing the attack than by doing this and by the early clearance of gardens once harvest is over.

In connection with the grain smut, *Spacelotheca sorghi*, a field experiment was carried out on the Experimental Station. The two seed treatments, suggested by Mr. Leach, are given below.

B. plots—Seed immersed in 2½ per cent. solution of copper sulphate for 10 minutes; dried and sown same day.

C. plots—Seed dusted with sulphur dust; 3 oz. dust to 60 lb. seed; seed and dust shaken up in a petrol tin until all seed well coated; sown same day.

A. plots—Control; untreated seed.

The layout was in the form of Fisher's randomised blocks with six replications and the 18 plots were each 1/10 acre in size. Unfortunately the damage done by stem borer in the field was great enough to mask any effect due to seed treatment and no significant results were obtained. A combined manurial and time of planting trial is being carried out next year to see whether it is possible to evade the borer attack to some extent.

Mention may be made here of the spacing experiment carried out on the station. The layout was again in the form of Fisher's randomised blocks with six replications and the six spacings under trial were as follows:—

		Plants per acre
36 in. rows with 12 in. between plants	1 plant per hole	14,520
36 ,, ,, ,, 24 ,, ,, ,,	1 ,,	7,260
54 ,, ,, ,, 12 ,, ,, ,,	1 ,,	9,680
54 ,, ,, ,, 24 ,, ,, ,,	2 ,,	9,680
72 ,, ,, ,, 12 ,, ,, ,,	1 ,,	7,260
72 ,, ,, ,, 24 ,, ,, ,,	2 ,,	7,260

Only the heads had been cut when the writer left and the grain was still unthreshed. From the weights of these, however, it appeared that the heaviest populations gave by far the heaviest yields and that thinning to one plant per hole resulted in heavier yields than leaving two.

This field was also badly attacked by borer and no great reliance can be placed on any of the results. This experiment will be repeated next year.

Maize.—The first and main crop grown in the *madimba* with the December and January rains was harvested during February and March and the yield was excellent in most areas. Cobs were large and well-filled and in many gardens the weight of seed to the acre was estimated at something between 1 and 1¼ tons. In the south Chikwawa and north Chiromo areas and in the Ndindi Marsh the crop yielded particularly well; along the west bank of the Shire River north of Chiromo and on the Lilanji stream banks the gardens suffered from the early drought and yields were not so heavy but even here the crop was fair and in places good. Practically none of the crop was lost to floods this year. Part of the second crop had been or was being harvested when the writer left. The yield was good.

A spacing experiment was carried out on the Experimental Station, the layout being in the form of Fisher's randomised blocks with six replications of each of the six spacings given below:

	Plants per acre
36 in. rows with 12 in. between plants	14,520
36 ,, ,, ,, 18 ,, ,, ,,	9,680
42 ,, ,, ,, 12 ,, ,, ,,	12,465
42 ,, ,, ,, 18 ,, ,, ,,	8,300
48 ,, ,, ,, 12 ,, ,, ,,	10,890
48 ,, ,, ,, 18 ,, ,, ,,	7,260

All plants were thinned to one per hole. The plots with 42 in. rows gave significantly heavier yields both in grain and straw. This experiment will be repeated yearly but in future on the *dimba* station and in succeeding experiments the native spacing of approximately 36 in. by 36 in. (3 plants to a hole) will be substituted for the 36 in. by 12 in. spacing, which actually gave the worst yield but one this year.

Notes have been kept of the Honduras maize and its behaviour under Nyasaland conditions. Some seed was supplied to the Empire Cotton Growing Corporation for use on their Domira Bay Station early this season and reports on its behaviour there will be of interest. Some has been supplied to natives on the Lower River and reports are very satisfactory.

Maere (*Eleusine coracana*).—The majority of gardens were planted out in February and losses were few. Many *dimba* maize gardens were interplanted with this crop. Harvesting commenced in May and by the end of the month was practically over. The yield was not quite so heavy as that of last year but the area under the crop was quite as large.

Rice.—This crop was planted with the late November and early December rains and harvesting commenced in March, although the main crop was not ready until April. Throughout the Lower River and particularly in the Ndindi Marsh the yield was excellent. The area grown was larger and the yield heavier than for some years past.

The Lower River natives do not look upon rice as a staple food. It is only used by bachelors and grass widowers who have no wives to make and cook *ufa* and have to shift for themselves. Practically the whole of the crop is sold to the Indians. Prices paid are small and too often the payment is made in kind, the trader refusing to pay cash to the native.

Sweet potatoes.—Most of last year's sweet potato gardens were flooded by the Shire's rise in late December and the few that were untouched were used to supply cuttings for planting in the *mpala* gardens in January. These small *mpala* gardens act as supply bases for cuttings for the

main *dimba* crop ,which was planted this year in April and May. The rains in these two months gave the cuttings an excellent start and large areas had been planted when the writer left the Lower River.

Pulses.—Green gram (*Phaseolus mungo*) was planted at various times in different areas through the rainy season and the yield was good. The short-term pulses did well, especially those planted early in the year, and some excellent crops of *Vigna* beans just ready for picking were seen in February. The main crops of *Vigna*, *Dolichos* and *Phaseolus* beans are not planted until about March and these were all looking healthy and beginning to flower by May. The Bambarra groundnut crop (*Voandzeia subterranea*) had begun to set its seed by February and was being earthed up. It was harvested in May and the yield was good. Pigeon pea (*Cajanus indicus*), a crop which is becoming increasingly popular in the Ndindi Marsh, was in flower by May and beginning to form pods in the earliest gardens. Sesamum was also in flower by May.

Groundnuts.—Upon the advice of the administrative department many natives on the Lower River planted groundnut gardens this year. During November 1931 they were told that the shelled nuts in 1932 would be bought at a penny per lb. and from a careful census carried out early in the year and measurements made of some 50 gardens taken at random it was estimated that there were 1,700 gardens with an area of 700 acres from which a crop of 250 tons of shelled nuts might be expected. The main crop was lifted in May.

Leaf discolouration was noticed in some of the gardens in February. Specimens were sent to Mr. Leach who indentified the disease as being caused by *Cercospora* sp., probably *C. personata*. The disease only appeared to attack the leaves after the seed was set and did not cause marked defoliation ; nor was the attack ever bad although it was found in most areas.

Native Agriculture in General.

No ploughing had been done up to the end of May and as trypanosomiasis had been found in the herd on the station just before the writer left it was doubtful whether any could possibly be done. This is the more to be deplored as there was every sign that natives were still as keen as last year to have their gardens ploughed in spite of the warning that they would be required to pay in advance.

In connection with the grain stores work was temporarily stopped during May owing to a rather serious outbreak of smallpox in the district. Previous to this, work on the new village stores had commenced in two villages.

A most encouraging sign has been the interest that natives have taken in the improved strains of seed on the experimental station. The Malayan cassava has been very popular and exchanges of maize and *machewere* seeds have been made.

The soil erosion problems still remain but will be tackled next year. Contour maps will be made of certain gardens which will be ridge terraced and used for demonstration purposes. The terraced pineapple plots built on Malawe Hill last year stood the rainy season well; the pineapples should bear next year.

During the early part of the year journeys were made to various parts of the Chiromo district, particularly to the very fertile stretch of *dimba* land lying along the east bank of the Shire River between Chiromo and Makwiras village in the Chikwawa area. In connection with the groundnut census, native grain store construction, ploughing of native gardens and general cotton and native food garden inspection, the whole of the Port Herald and Chiromo areas was visited at one time or another. South Chikwawa area was also visited but it was found impossible to leave the experimental station for long enough to pay a visit to the north Chikwawa area.

Propaganda work on seed selection, suppression of ratooned *mapira*, destruction of *Striga* and clean gardens has continued, with apparently no result on the native mass population. One or two headmen have come this year to the experimental station with a request to be taken round and have shown a very intelligent interest in the work being done. These visits have always been followed up by the writer with a visit to their villages and there is no doubt that in these few examples a real step forward has been made. There are also about ten native small-holders who come regularly to the station for seed, help in ploughing and general advice about their gardens. They are more intelligent than the average, and their interest and help as demonstrators is very valuable.

Native Agricultural Instructors.

During the first three months of the year the instructors were very busy in their districts with the young cotton crop, checking issues of seed, measuring up larger gardens and urging early planting. Towards the end of January and during the whole of February, the three in the Port Herald area were engaged on a groundnut garden census. Propaganda work on bird-scaring in the millet gardens, the destruction of ratooned *mapira* aud seed-selection has been carried out consistently. During March and April each instructor was responsible for a report on the prevalence of *Striga* in his own district and in May they commenced the cotton garden census.

The farm diaries have been continued and are of increasing value both in keeping the instrue tors at their work and in keeping the writer in touch with his district.

Communal Village Grain Stores.

The necessary improvements outlined in last year's report have been carried out on the experimental station's stores and have been incorporated in the two new village stores; those at Makoko's and Mlolo's villages will be altered before they are filled. From last year's experience the two weak points were found to lie in the method of closing the top of the store and in the necessarily frequent removal of the roof for filling, fumigating and emptying purposes which resulted in rapid deterioration and constant need for repair. A damaged roof that let in water would soon lead to mould in the grain and an unsatisfactory method of closing the top would soon lead to weevil infestation. In each store now a small wooden door has been fitted in the side, the top of the door frame being level with the upper edge of the circular wall. The door is about 1 ft. 6 in. square, just large enough to allow a native to enter, and complete with frame and leather hinges can be made by any village carpenter very cheaply and quickly. With regard to the top of the stores, frames have been put across from side to side and the whole mudded over with a 6 in. layer of mud finished by a final plaster of a mixture of wood-ash and cow dung. Each store can now be filled without removing or touching the roof, and, although it is admitted that the operations cannot be carried out quite so easily or quickly as before, the resulting safety more than adjusts the balance. No difficulty has been experienced on the station in any of the operations and native maize stored early in the year was in perfect condition when the writer left. After the store has been filled and fumigated the door is closed and completely mudded over.

As already noted a bad attack of smallpox in May stopped work on the two new grain stores then nearing completion, and although village headman Makoko had already collected material for a second store it had been impossible to commence construction.

Port Herald Experimental Station.

The Department of Agriculture took over the Port Herald Experimental Station from the Empire Cotton Growing Corporation on January 1.

During the early part of the year 10 acres of *dimba* land were cleared and marked out into four fields of 2½ acres each. By the time the work was finished it was too late in the year to plant and owing to sickness in the cattle it had been impossible to plough the land. The station now consists of 50 acres of *mpala* land (twenty 2½-acre fields) and 10 acres of *dimba* land (four 2½-acre fields).

Of the twenty 2½-acre *mpala* land fields under cultivation this year ten were under cotton and ten under native food crops, this being the second year of the two-course rotation scheme. This two-course rotation has been found unsatisfactory in many ways and will be superseded next year by a variety of two-, three- and four-year rotational and inter-cropping trials. The main objection to the two-course rotation of cotton and grain crop is that the cotton cannot be out of the ground in time for the proper preliminary cultivation of the land for the grain crop and too often is still in the ground when the succeeding crop should be planted.

Interplanting trials have been continued this year and some of last year's results have been repeated. The three principal grain crops of the district, pigeon pea and pulses were all tried with cotton. In all five cases planting was carried out in 4 ft. lines. Between *machewere* the cotton seemed quite happy, the effect of the millet in suppressing the lower laterals being distinctly beneficial; the cotton was flowering well and the millet had given as good a crop as anywhere else on the station. Between maize the cotton did well too, but the maize itself was practically a failure. Between *mapira* the cotton made very poor growth and was evidently unhappy. It did not look as though it would pick up again even after the *mapira* was taken off. The *mapira* gave an average yield. Pigeon pea (*Cajanus indicus*) in 4 ft. lines appeared to completely smother out the cotton which barely grew at all. It appeared as though wider spacing of the pigeon pea was desirable, the shade effect on the cotton being altogether too strong for healthy growth. In the case of cotton and pulses the kind tried, Lima beans, was an almost complete failure. Those that survived grew well and the cotton was well developed and flowering heavily.

The most interesting result from these trials, which will be repeated next year, is the successful interplanting of *machewere* and cotton. It is still a matter for trial to decide the best stage at which to interplant the cotton, but the importance of the result lies in its application to native agriculture. It is becoming increasingly obvious that clean fields may be far more dangerous than weedy ones and that a cover of some sort is absolutely essential to check erosion during the rainy season and heavy evaporation during the dry. The mixture of *machewere* and cotton certainly provides a heavy cover during the greater part of the year, the grain crop being planted with the beginning of the rains, in late November, and the cotton interplanted some time in January, probably the earlier the better. By the time the *machewere* is ready to harvest the rows of cotton are beginning to close over and form a complete shade. Another point in its favour is that the native prefers to have more than one egg in his basket and will not be ready to take to definite rotations for some years yet. A suggested two-year rotation is a mixture of *machewere* and cotton followed by a half pulse and half groundnut crop.

The spacing trials of maize and *mapira* and the seed treatment trials of the latter crop have already been mentioned under the crop notes With cotton various strain tests are being carried out and the spacing trial of last year repeated. Mr. R. S. Sennitt, General Manager of the Compagnie Cotonniere du Mozambique, is carrying out exactly similar trials, as he did last year, at Nova Chupanga on the Zambezi river, 50 miles due South of Port Herald. One strain

(PU4/5-12) was showing signs of being definitely jassid-susceptible and all the seed from this strain should be destroyed before it mixes in the ginnery with the main bulk. This particular strain gave poor results in the strain test last year, both at Port Herald and up-country.

Various cropping systems have been tried out, such as cotton after catch crops of the smaller millets (*Panicum* and *Setaria*), *Dolichos* beans after broadcast *machewere* and the interplanting of grain crops with pulses. Observation plots of all the local native food crops and of the various types of millets and maize have been kept, and next year maize and cotton trials will be carried out on the *dimba* station. The Honduras maize continues to do well but the soil on the *mpala* land station is too light for successfull maize growing and no real opinion on its merits can be given until it has been tried out on *dimba* land. Two samples of *Pennisetum* seed from India have proved to be slow maturing awned types like the local *nachacha* and of no value to the district, but a sample from the Transvaal gave a dwarf large-headed early type which should prove very useful. A small sample of Japanese Bunch groundnut seed from Swaziland was badly attacked by a leaf disease caused by *Cercospora* sp. but the yield was fair and the nut of excellent quality. The two imported varieties of Sorghum (*mapira*), one from Portuguese East Africa and one from India are of doubtful use because of their extreme susceptibility to weevil attack, the grain in both cases being very soft and storing badly. A collection of the local varieties of *mapira* was sent to the Royal Botanic Gardens, Kew.

A silage pit was constructed on the station and filled with chopped maize and *mapira* grown for the purpose on two ¼-acre strips. The pit was well trampled down, allowed to settle, filled up again, trampled down again, mudded over and roofed. The operations were completed in May. The crop was on the mature side, the maize in tassel and the sorghum in head, the latter in the "dough" stage advised by the American workers.

Stock.—It is sad to have to report that the cattle on the station have typanosomiasis. This was suspected early in the year but no trace could be found in various blood slides sent in to the Veterinary Department until early in May. The cattle were undergoing their first injections when the writer left. Among the deaths was one of the plough bullocks and the loss, with an extra 10 acres under cultivation, is a serious one. Milk records were kept but owing to the effects of disease the yields were probably lower than they would normally have been; the highest was 150 gallons. No extra feeding was given, the cows were milked every morning and the calves allowed to run with their mothers during the day. The herd of goats and flock of sheep increased steadily and will be used for some grazing experiments next year. Six wethers were in the fatting pen when the writer left. Simply constructed hurdles and portable feeding racks have been made on the station for use in the covered yards.

E. Lawrence,
District Agricultural Officer.

Report of the District Agricutural Officer, Lower Shire and Chikwawa.

PART 2.

I arrived at Port Herald from North Nyasa in June to take over the experimental station together with the duties of District Agricultural Officer in the two districts mentioned. Mr. Lawrence whom I relieved then proceeded on leave.

METEOROLOGICAL.

Tables 1, 2 and 3 have been completed and table 4 added that direct comparison of the last three seasons may be made. It will be seen from a study of table 4 that the cotton crop was favoured with a well-distributed rainfall which was adequate for the crop where planting was completed sufficiently early in the season. This applied particularly to the heavier and more retentive soils of the Chiromo area, but in the Port Herald and Chikwawa district areas of light sandy alluvium or *mpala* land, as it is known, the rainfall was inadequate and especially was this the case where planting took place after the end of January. In the late-planted *dimba* areas seasonal conditions were favourable to all crops.

COTTON.

Full details of figures that shed light on both the crop and industry have been prepared in tabular form and these follow at the end of the report.

At the close of the season ended it is gratifying to be able to record an increase in production over the preceding season and the more so when is taken into consideration the fact that there was a very substantial shortfall in the number of natives who continued to exploit cotton as a means to obtain money wherewith to discharge their hut tax obligations and also to provide themselves with an ever increasing number of articles which they covet as the normal outcome from the onward march of time and progression. The shortfall in growers from the season 1930-31 amounted approximately to 36 per cent. with a rather heavier fall-off in the number of gardens. The latter can be taken to represent the peasant farmer type. There has been a steady decrease in the number of native growers since 1929 and the main factor responsible for it has been falling prices. The rather poor season in 1931 and a reduction in the number of markets from eleven to four abetted the waning of interest that had arisen solely out of the question of prices paid. This year the additional markets of Munga and Makwira were granted by The British Cotton Growing Association thus making a total of six markets in all. Market prices obtained will be found in table 7a. The increase in production amounted to 402,162 lb. This was due essentially to the more widespread use of *U4* seed in place of the former *Nyasaland Upland* and to a season that favoured the crop where grown in the heavier soils on account of the greater power which the latter have to retain soil moisture. The Chiromo area with its high proportion of excellent soil undoubtedly made the total as satisfactory as it was. On the lighter *mpala* land soils an undue amount of late planting was responsible for the total crop being appreciably lighter than it might well have been. The present general tendency for natives to plant cotton too late in their light sandy *mpala* land gardens is a feature of bad agricultural practice born of recent years for, if it did exist formerly, its presence then was not strikingly apparent. The Port Herald area is an outstanding example and columns 8, 9 and 10 of table 6a bear forcibly upon this lamentable feature which has crept in. The matter is receiving serious attention in order to eradicate the evil for there need be no conjecture on the subject of dates for planting cotton in *mpala* land soils if the question of plant growth and development are to receive their due amount of consideration. Natives are therefore being actively stimulated to plant as early in the season as suitable rains allow for. In this connection it is of interest to draw attention to the significant results in favour of early planting provided by the time-of-planting experiment conducted on the experimental station. The outlook for 1933 is brighter and despite the knowledge that market conditions do not forecast any improvement in prices there is every reason to suppose that there will be a substantial increase in the number of growers in the on-coming season when only *U4* seed will be in use throughout the districts. This renewal of interest comes of that all-compelling factor, a shortage of money. Many natives have felt the miss of what others have attained through the use of better seed and greater diligence and, short of leaving their homes and the district, cotton alone for the present offers to them an assured cash return for agricultural enterprise. This renewed interest is being actively pursued and the opportunity taken to further greater measure of sound agricultural practice in the cultivation of the crop in order that the grower may reap full measure of benefit from his labours.

Uprooting.—For this season cotton plants had to be uprooted and burnt by November 30 instead of as late as December 15 in the previous year. It might well have been anticipated therefore that there would be an increase in the number of offenders under the Cotton Rules. The stringent call for economy did not allow of the employment of additional supervisors for the work of inspection and this devolved upon the permanent staff of the department. Every help and support was accorded by officers of the district administration and is gratefully acknowledged. To the help of the latter as well as to the rectitude of native cotton growers themselves is due in no small measure the very satisfactory execution of this regulation as the figures covering offences portray.

District			Offenders		Per cent. of actual growers
Port Herald	...	...	26	...	.8
Chiromo	...	...	44		
Chikwawa	...	...	43	...	1.0

Seed supply.— The Lower River areas have supplied 55,100 lb. of U4 seed from the 1932 crop in order to meet the requirements of up-country cotton-growing districts.

Groundnuts.

Reference has been made already in part one of this report to the efforts that were put forward to create a local industry in this crop. It is possible that there was a slight increase over normal acreage as a result of this stimulation but it would not be in excess of 25 per cent. (estimate). The crop harvested fell short by approximately 10 per cent. of the original 250 ton estimate but otherwise its disposal was accounted for. Late rains coincided with too frequent instances of delay in harvesting and an appreciable quantity of nuts was spoilt on that account. Buying stations were established at Dumba and at 15-mile siding on the railway. The price paid at these markets was $\frac{5}{8}$d. per lb. of shelled nuts. A feature of quite a number of minor agricultural industries in Nyasaland is their association with the Indian trader who more often than not purchases his requirements through the means of barter. Large quantities of the 1932 groundnut crop found a way into the many stores throughout the district in this manner. Natives are frequently heard to lament this practice but nevertheless it continues even in the face of the fact that money could be obtained for their produce in certain instances if they elected to carry it to the nearest market buying in terms of cash. It may well be that the native possesses an inherent liking for barter which until comparatively recent times was his only means of making purchases either from his own people or from the traders who first came to the country.

The light *mpala* lands of the district offer very suitable conditions for the cultivation of the crop and at $\frac{3}{8}$d. per lb. the acre value would certainly be no less than that of cotton at its present figure. To the small grower working his own garden it would be considerably more. An assured and organised market is required but given these two essentials the crop could be safely recommended and fostered for those areas which carry the type of soil referred to above. The crop itself would not only provide a circulation of money earlier in the year but its cultivation would tend to improve those tired *mpala* gardens such as are in the habit of producing an early-planted crop of *machewere* (*Pennisetum typhoideum*) which frequently is followed through by cotton in the same year. This latter practice does not allow the land any rest period at all whilst with groundnuts lifted in May to June a rest period of full five months would be provided.

Rice.

Preliminary investigations indicate that nineteen named varieties (?) are known to natives who cultivate rice on the Ndindi Marsh areas where the conditions represented appear altogether suitable to it. Native seed stocks appear to be badly mixed and require investigation. Attention to pure seedings, correct time of harvesting, better milling, the introduction of grading and better preparation for market should well repay efforts in that direction and these are points which are now receiving attention along similar lines to those that were employed in the recent improvement of the North Nyasa crop. It is reasonable to suppose that in the wake of improvement may follow a ready market for an article of quality. Observation plots have been sown in a native-owned rice cultivation in order that data on growth and other points may be obtained. Later on, mass seed-selections of varieties will be made in native cultivations to supply the seed necessary for the work of investigation and experimentation to be commenced in 1933-34 on the *dimba* station that has been acquired recently. An attractive possibility is one of double-cropping rice and cotton in one season and for this purpose a good short-age variety of rice will be sought after.

Black Gram.

This pulse (*Phaseolus radiatus)* is cultivated primarily for sale to local Indians by whom it is valued as a food. The acreage under the crop is a small one.

District and General.

Communal village grain stores.—The scheme was continued but there is little evidence, if any, to suggest that the idea is taking on. The total number of contributions was only 252 amongst three stores and but little more than half of these were entirely voluntary. The average contribution was just over 36 lb. or approximately the food supply of one family for one week. This is not very encouraging but the idea is a new one and foreign to an individualistic family system instinct which appears to dominate the mode of life of the Amanganja people. The experiment has been tried out in two seasons now and proof given that grain can be stored and retained in so satisfactory a condition as to induce a more provident outlook towards food conservation, and the real test of its success or failure will depend now upon a request from the people themselve for a continuance of the scheme accompanied by larger individual contributions.

Ploughing of native gardens.—Further ploughing demonstrations were carried out and four gardens computed as 8.25 acres were ploughed this season at the request of their respective owners. The fees charged were readily paid up in full. It may now be expected that the native-owned plough will make its debut in these parts as it would no doubt prove to be a considerable asset where used judiciously by the native peasant farmer whose greatest difficulty is perhaps that of providing himself with labour for the initial preparation of the acreage he wishes to cultivate.

Unfortunately these acreages where I have come in contact with them have tended to err on the large side for best results and it is to be hoped therefore that the coming of the plough may not present that feature here. Big acreages which are badly handled return poor yields in both kind and cash and discontent is the result.

Locusts.—During the last few months of the year the migratory locust, *Locusta migratoriodes R.* and *F.* has made several invasions into the district and its close proximity in neighbouring territory leaves us liable to still further and more extensive invasions than those which have already occurred. As a precautionary measure natives have been encouraged to extend their areas under such crops as sweet potatoes, cassava, groundnuts and the various pulses as a standby against the possible loss of their graminaceous crops. Efforts have also been put forward through the district native agricultural staff to instil into the populace the main principles of anti-locust measures.

The Experimental Station.

With the exception of some late-planted *Dolichos* beans, pigeon pea and sweet potatoes as they occurred in the various crop rotations, cotton harvests alone remained to conclude work on the 1931-32 scheme of cropping. Details of the various trials, tests and experiments with cotton have been given expression to in part 1 of this report.

Cotton.—There were 25 acres under cotton grown for experimental purposes. The highest acre-yield obtained was that of 567 lb. seed cotton from a 2½-acre propagation plot under strain *P.U.4/5-5.* The average yield of seed cotton to the acre was 243 lb. but this is no criterion as many low yields were associated with extreme tests necessitated by experimentation. The experiments included a wide range of mixed cropping systems, strain tests, time-of-planting and spacing trials. By the courtesy and help of Mr. F. Stephens it was made possible to replicate the strain test in full detail under the heavier soil conditions which are represented by the Maperera estate in the Chikwawa district. It is regretted that from the various cotton experiments the only figures which gave significant results were those from the time-of-planting trials and these are given below.

Treatment	Yields (mean of six plots)
A. 4th January	13.2
B. 15th January	9.5
C. 1st February	13.0
D. 16th February	3.7
E. 4th March	2.6
F. 15th March	1.3

Z = 1.075 (to be significant Z should be greater than .6747 when P = .01)

Significant difference between means (P = .01) = 7.13

Standard error of one plot 4.5 or 62.6 per cent. of mean.

Therefore A and C treatments are significantly greater than D, E and F and B is significantly greater than F.

The results obtained in the series of mixed cropping systems suggest major possibilities with maize, beans of the bush variety or *machewere* whilst *mapira* and pigeon pea would appear to be unsuitable combinations. The closest co-operation with the Cotton Specialist continues to be maintained and cotton field experiments are conducted in collaboration wherever conditions and circumstances make this desirable feature possible.

Other crops.—Small observation plots have been established to accommodate various introductions whether of local or foreign origin. In the coming season these will include for observation and seed multiplication *black gram, crested wheat grass* and *kotikoti* (vern.). The latter is a cultivated grass that has been found sparingly represented in local native cultivation. It is a variety of *Setaria italica*, probably *rubrofructa.*

Stock.—The animals infected with trypanosomes were successfully treated with the exception of one case where the disease had evidently attacked the central nervous system before treatment could be rendered. Surplus male stock have been castrated and three of mature age broken to the yoke. An area of land has been provided in which suitable grazings will be sown and observations made upon their value.

Staff.

With one or two exceptions native instructors have applied themselves with diligence to their duties. They have worked well and if they have fallen short on occasions it has been more due to a lack of more suitable training to equip them for their duties in the field than to any shirking of the work they have been given to carry out. All things taken into due consideration they do amazingly well.

Acknowledgements.

Messrs. G. M. Boby and F. Stephens have again rendered much help in a variety of ways to the department. District commissioners have afforded the closest co-operation and interest in all phases of district agricultural matters and the management of Messrs. The British Cotton Growing Association have continued to give useful assistance and collaboration in connection with the native cotton industry. Thanks are due to all concerned for their help and courtesy which is gratefully acknowledged and much appreciated.

Frank Barker,
District Agricultural Officer.

Table No. 1.

Port Herald Experimental Station, Meteorological Records, 1931-32.

	Av. monthly temperatures Max.	Min.	Range of temperatures Highest max.	Lowest min.	Rainfall, in.	No. of days rain	Remarks.
1931							
November	95.3	74.9	105.5	71.0	1.05	3	Rainfall effective
December	92.4	74.3	104.5	70.5	4.45	18	Approx. 75% rain effective
1932							
January	94.0	75.3	104.0	66.0	7.15	10	Approx. 50% rain effective (1 heavy fall of over 4 in.)
February	92.5	74.3	100.5	70.0	5.41	12	Rainfall effective
March	90.8	73.0	96.5	66.5	4.06	11	do.
April	90.4	71.8	97.0	67.5	1.63	6	do.
May	84.1	66.0	92.5	59.5	1.37	5	do.
June	82.8	57.7	88.5	49.0	.23	3	
July	82.7	58.4	102.5	51.5	.41	4	
August	81.5	58.3	95.0	51.5	.16	4	
September	95.9	69.2	105.0	55.5	.51	3	
October	98.2	72.9	106.5	65.0	.08	2	
November	95.4	72.7	109.0	59.0	4.17	7	
December	93.5	75.1	107.0	71.0	14.28	17	

Table No. 2.

Comparison of Monthly Rainfall Totals for 1932 with Monthly Average Totals for previous Five Years in Inches.

		Average for previous 5 years
1932		
January	7.15	6.88
February	5.41	3.83
March	4.06	6.17
April	1.63	2.03
May	1.37	.41
June	.23	.58
July	.41	.42
August	.16	.33
September	.51	.08
October	.08	.29
November	4.17	1.75
December	14.28	6.71
	39.46	29.48

Table No. 3.

Port Herald, Chiromo and Chikwawa Rainfall, 1931-32.

	Port Herald.		Chiromo.		Chikwawa.	
	In.	Rain-days	In.	Rain-days	In.	Rain-days
1931						
November	1.05	3	.60	?	.73	?
December	4.45	18	8.33	7	10.11	12
1932						
January	7.15	10	4.49	9	4.17	10
February	5.41	12	4.23	8	3.90	9
March	4.06	11	4.05	8	4.72	11
April	1.63	6	1.68	4	1.18	7
May	1.37	5	2.03	9	2.15	8
June	.23	3	.04	1	.24	1
July	.41	4	.37	3	.33	2
August	.16	4	.14	?	.27	7
September	.51	3	—	—	—	—
October	.08	2	—	—	—	—
Total	26.51	81	25.96	49 (?)	27.80	67 (?)
Season 1931-32						
November	4.17	7	2.57	?	3.05	6
December	14.28	17	10.63	?	9.37	17

Table No. 4.

Season Rainfall, Port Herald, Over Last Three Years.

	1929-30		1930-31		1931-32	
	In.	Rain-days	In.	Rain-days	In.	Rain-days
November	2.21	6	.82	4	1.05	3
December	7.21	10	7.07	15	4.45	18
January	2.28	11	6.22	17	7.15	10
February	1.13	6	5.53	17	5.41	12
March	9.50	10	1.85	9	4.06	11
April	.93	7	3.03	11	1.63	6
May	.66	4	.23	3	1.37	5
June	.80	4	.99	9	.23	3
July	.29	5	.27	1	.41	4
August	.37	2	—	—	.16	4
September	.60	1	—	—	.51	3
October	.02	1	1.01	3	.08	2
Total	26.00	67	27.02	89	26.51	81

1931-32. *Seasonal notes on crops*:—*Machewere* poor; *mapira* good; early-planted cotton good; late-planted cotton saved from complete failure by good rains in May; maize good; ground-nuts good but some spoiling occurred through delayed harvests and late rains; sweet potato crop returned a heavy yield of well-formed roots which were remarkably free from attack by the Curculionid weevil, *Cyclas compressus* Hartin.

Table No. 5.

Census of Cotton Growers and Gardens.

LOWER SHIRE DISTRICT	Section	Growers Male	Growers Female	Total	Total decrease from 1931	Gardens Large	Gardens Small	Total	Natives employed in large gardens	Total decrease from 1931
(Port Herald and Chiromo)	Tengani ...	1,455	31	1,486	1,936	12	1,496	1,508	6	1,991
Growers down by 34 per cent. approx.	Ngabu ...	476	42	518	335	8	506	514	12	346
	Nachikadza	1,390	75	1,465	656	13	1,493	1,506	29	913
Gardens down by 37 per cent. approx.	Ndamera ...	622	20	642	698	32	641	673	43	711
	Chimombo ...	712	11	723	330	3	723	726	7	363
	Chipwembwe	865	52	917	110	—	937	937	...	171
	Mlolo ...	2,764	41	2,805	521	126	2,787	2,913	417	609
	TOTAL ...	8,284	272	8,556	4,586	194	8,583	8,777	514	5,102
CHIKWAWA DISTRICT	Ngabu (S.)...	751	—	751	339	—	751	751	—	379
	Ngabu (N.)...	285	25	310	184	41	278	319	—	211
	Beleu ...	138	5	143	486	19	124	143	—	492
	Daniel ...	144	8	152	370	9	143	152	—	402
Growers down by 47 per cent. approx.	John ...	407	45	452	457	44	416	460	—	549
	Katunga ...	132	11	143	455	7	137	144	—	500
Gardens down by 50 per cent. approx.	Ndaeni ...	156	5	161	609	14	147	161	—	623
	Makwira ...	1,916	221	2,137	923	494	1,701	2,195	—	1,171
	TOTAL ...	3,929	320	4,249	3,823	628	3,697	4,325	—	4,327
	GRAND TOTAL ...	12,213	592	12,805	8,409	822	12,280	13,102	514	9,429

Table No. 6a.

	1	2	3	4	5	6	7	8	9	10	11	12
District and/or/ Area	No. of applicants for seed	Average issue per applicant in lb.	Average seed issue per Grower in lb.	Average seed issue per garden in lb.	Total seed issued in lb.	No. of growers	No. of gardens	Average production factors: per lb. seed issued	per grower in lb.	per garden in lb	No. 1 grade per cent.	Notes and Remarks
Port Herald ...	5,255	19.75	20.6	20.8	100,279	4,870	4,969	9.1	187.7	183.9		Low production mainly due to late planting in *mpala* land
			U/4 seed									
Chiromo ...	6,302	23.75	40.8	39.4	150,403	3,686	3,808	23.3	951.7	947.4	93 approx.	Area of best soil, good use made of seed and larger gardens
			U/4 seed									
Chikwawa ...	6,607	23.90	37.2	36.5	158,138	4,249	4,325	9.7	359.4	353.1		Only 17 per cent. or 26,680 lb. U/4 seed was available for issue
			Nyasaland Upland & U/4 seed									

Table No. 6b.

Summary.

Lower Shire and Chikwawa Districts.

1	2	3	4	5	6	7	8
					Average production factors		
Total No. of applicants for seed	Total seed issued in lb.	Total No. of growers	Total No. of gardens	Total crop in lb.	per lb. of seed issued	per grower in lb.	per garden in lb.
18,164	408,820	12,805	13,102	5,949,163	14.5	465	454

Table No. 7a.

Crop Production and Sales.

District and/or/area	Crop		Total	Average price paid		Value of crop		Total	Average value per grower
	No. 1 lb.	No. 2 lb.	lb.	No. 1 d.	No. 2 d.	No. 1 £ s. d.	No. 2 £ s. d.	£ s. d.	£ s. d.
Port Herald	760,878	152,934	913,812	.66	.37	2,084 9 2	233 4 11	2.317 14 1	— 9 6.2
Chiromo	3,299,659	208,395	3,508,054	.59	.25	8,326 1 9	215 17 11	8,541 19 8	2 · 6 4.1
Chikwawa	1,474,478	52,819	1,527,297	.525	.25	3,271 18 4	54 13 0	3,326 11 4	— 15 1.3

Table No. 7b.

Summary.

Total crop	Increase of crop over 1930-31	Total value	Increase of value over 1930-31	Remarks
lb.	lb.	£ s. d.	£ s. d.	
5,949,163	402,162	14,186 5 1	2,817 4 9	Increase mainly due to Chiromo area.

Annexure B.

Report of the District Agricultural Officer, North Nyasa.

A maxim of good generalship is to consolidate ground gained and it is therefore regretable that the exigencies of the service and an inadequate staff of district agricultural officers made this impossible through my transfer from the district to Port Herald in June.

During the two years that I was stationed in the district I made a close study of the various agricultural problems which North Nyasa presents. They are numerous but definite progress in native agriculture was achieved though much still remains to be investigated. It is satisfactory to be able to record that the sympathies and confidence of the natives which are so essential if progress is to be made seem to have been won in part at least. It is to be hoped therefore that the ground broken may not be left fallow for long and that circumstances may soon provide an officer to continue with the work already carried out during the 1930-1932 period.

Meteorological.

The season 1931-32 was a very wet one. The rains broke on November 19 and finished on May 18 with a total precipitation for the period of 71.20 in. Table 1 gives the seasonal rainfall registered at Karonga. It reads 14.175 in. above the seasonal rainfall average for the five years immediately preceding the season 1931-32.

Table 1.

Month	Rainfall in inches	Number of days on which rain fell
November	6.47	... 5
December	16.56	... 16
January	5.46	... 13
February	6.32	... 10
March	23.58	... 17
April	10.14	... 16
May	2.67	... 4
Total	71.20	... 81

Crops and General.

Harvests throughout the district were very generally good, this happily so despite the exceptionally heavy rains, much of which coincided with the ripening period of maize and millet crops. Nevertheless, the food situation for the year left little to be desired, although at one time it was thought that considerable losses might have resulted through the spoiling of grain under wet harvesting conditions.

Adverse markets denied to the North Nyasa native the possibility of disposing of any cotton that might have been grown and seed was therefore not issued. The rice industry of the Lufira-Ngerenge-Tsongwe areas went ahead in a flourishing manner, and the excellent quality of the rice as the outcome of pure-seeded cultivations, better harvesting, grading and marketing very clearly indicated that full use had been made of advice and instruction given to growers.

Free distributions of seed of groundnuts and soya beans were made in small quantity as shown in the table below and the extension of these introductions to the district was watched and assiduously fostered.

The benefits to health that will result if it can be brought about that the highly nutritious soya bean is included in the native dietary must be very considerable and it is to be hoped therefore that natives will take kindly to this pulse and find a generous place for it in their cultivations. At the time of my transfer harvesting of the latter crop had not been completed and therefore I had no opportunity of studying the native attitude in regard to it, but records are kept of all distributions made in order that they may be followed up and interest maintained.

Table 2.

Crop	No. of recipients	Seed issued in lb
Soya bean (*O-too-tan* var.) ...	107	... 180
Groundnuts (*Spanish bunch* var.)	31	... 721

The soap industry commenced in 1931 by Mr. Maxwell of Nyungwe Estates continued to provide a local demand for native-grown groundnuts. Mr. Maxwell does his own pressing and oil extraction and the soap he manufactures in considerable quantity appears to be of fine quality.

Locusts.

There seemed every probability in July of 1931 that the migratory or hairy-chested locust (*Locusta migratorioides*, R and F.) which has been progressing throughout Africa now for some years would reach the North Nyasa district at no distant date. Patrols were therefore posted at suitable strategic points along the north-west and west-north-western borders of the district in order that first-hand information would be sent forward to Karonga with all speed should invasion occur, and also to ensure that the line of advance taken by invading swarms might be kept track of.

Before proceeding to their several bases, patrols were schooled in anti-locust measures. An additional duty of these patrols was to encourage natives to increase their acreages under dicotyledonous crops, it being known that the main food plants of the migratory locust are the

monocotyledons, especially members of the large natural order *Gramineae* both wild and cultivated, though it is on record that dicotyledons also may be attacked in isolated cases. With the object of making the food situation as secure as possible full particulars of crops to be planted and details of anti-locust measures, including the presence and duties of locust patrols, were widely circulated amongst all principal headmen, educated natives and others, the need for whose fullest co-operation was urged. These details were typewritten and simply expressed in Kyngonde, in Chehenga and in English. Every occasion was also taken to lecture natives fully upon this subject and if as a result of these efforts the response was not everywhere as strikingly apparent as it might have been its lack was at least in keeping with the somewhat fatalistic outlook of the African upon life generally. The course of subsequent events must have demonstrated the value of the advice offered, and later developments served to prove that the spirit of co-operation may be astoundingly good amongst the natives when there is a common menace.

The first invasion took place on January 24 and 25 when swarms from Tanganyika Territory approached in a south-south-easterly direction and crossing the Tsongwe River entered the country known as Ulambya where they settled in an area a few miles to the west of Principal Headman Nyondo and ninety odd miles north-west from Karonga. Young fingermillet came in for major attention from the locusts but on the whole damage to crops was relatively light. Breeding and egg-laying commenced almost at once. Careful examination of the country-side revealed three egg-laying areas closely associated with native cultivations and their fringes to a total of 1,200 acres. These areas were individually investigated and demarcated. It was ascertained that the density of egg-laying was light and ranged from one egg mass per 100 square feet to two-egg masses per 9 square feet, this very favourable state of affairs being due in no small measure to the active and unremitting efforts of the natives who from the outset combined to attack swarms under the leadership of patrols. The demarcated areas received daily attention again under the guidance of the locust field staff, and so thoroughly was the work of egg-destruction carried out by digging that when the emergence of hoppers took place they were present in such restricted numbers that their extermination presented little difficulty and was completed in all three of the invaded parts of Ulambya.

The second invasion occurred on March 5 and 6, the locusts entering the district in a dense swarm at about six miles east of the former point of entry, and the damage to crops was very considerable. Immediately upon their arrival they were attacked and the migrants were not left unmolested until they were driven from the district over the N. Rhodesian border on March 7.

On March 19 a further swarm entered the country of Ulambya from the west and received the same organised unrelenting aggression as on previous occasions with the result that it was driven out into N. Rhodesia on March 26.

No egg-laying took place during the invasions of March 5, 6 and 19. Damage to crops extended to a partial or total destruction of 965 gardens or 83 per cent. of the cultivations of twelve villages. The number of garden owners who had their crops ravaged was two hundred and sixty-three but as the season of the year was still favourable they required little encouragement to plant up pumpkins, beans and sweet potatoes wherever possible and cassava cuttings which were issued in considerable quantity gratuitiously and were readily accepted.

The work of patrols and the co-operative spirit of the natives themselves warrant commendation. Under exceptionally trying conditions in difficult country cut up by rivers nearly always swollen by the almost incessant rains, the locust field staff performed their arduous duties over a long period of months in a most praiseworthy manner.

To their energies and particularly those of N. A. I. Shem Mwakasangula is due every credit for restricting and preventing the extension of the swarms to other parts of the district. Able organisation of the native populace to deal with the menace not only prevented egg-development such as would have threatened other parts of the district but kept the swarms on the move and so prevented egg-laying on a far more extensive scale than actually took place. To Capt. J.O' Brien, District Commissioner, however, must go full credit for the able manner in which he inspired in the natives that spirit of co-operation to which reference has already been made. The work of Mr. R. Church, Assistant District Commissioner, and Mr. H. B. Cattrall, Stock Inspector, in connection with the locust compaign is also gratefully acknowledged.

Large numbers of the egg-masses dug up in February were covered by a mould-like growth as described in my report C/34 dated 22/2/32, in which connection it was of considerable interest to learn from N. E. Rhodesia in April that adults which had there been captured exhibited fungoid growths. A small number of the locusts constituting the first swarms were found to be parasitised by flies, doubtless Tachinids, as duly reported also.

Cattle.

As the outcome of my travels in the district, I prepared and submitted a short report upon the cattle-keeping problem in relation to agriculture, a matter of very real importance since there are no fewer than 33,000 head in North Nyasa (one head per 13 acres in the most densely stocked areas) and the numbers are rapidly increasing for the native views his cattle largely as currency only, neither profiting by the consumption of the meat himself nor having a ready market at his door. I drew attention to the detriment to agriculture which must be the certain result and also to impoverishment of grazings which must be the final outcome of over-stocking.

Rice.

I continued my endeavours to improve this crop and raise the standard of the industry as during the two previous years. Considerable progress is recorded, and general evenness of both stands and ripening must now be apparent to even the most casual eye. This is largely an outcome from the use of pure seeding and selected seed. The grower has been encouraged to make the latter for himself by mass field selection and the procedure has been suitable demonstrated

whenever possible. The improved quality of the crop is largely attributable to this and to organisation of the market. Without the latter essential much of the good result from spade work in the field would have been lost, and the efforts of the progressive grower would have been at a discount. The system of grading introduced in 1931, prior to which no grading was attempted, continued to be developed and the benefits to the grower and to the district were increasingly appreciated. It is believed that the industry has been set on a sound footing; a study of the figures included in table 3 is indicative of the progress that has been made.

Prices for rice have remained as for the previous year, namely, at 4s., 3s. 6d. and 3s. per 60 lb. for grades Nos. 1, 2 and 3 respectively. This year the market was more highly organised and open to competitive buying, but owing to trade depression there was little competition. In the absence of the District Agricultural Officer the market at Kaporo was supervised and directed by Mr. Lee, an officer of the Colonial Office seconded to the district administration of this country, who was assisted by the trained native staff of this department. His work was of very material value and is gratefully acknowledged.

The total crop marketed amounted to 252,180 lb. but this amount would have been greatly exceeded had there not been the menace of locusts which induced growers to hold in reserve against food requirements larger supplies than normal.

Table 3.

Grade	1931 lb.	1931 per cent.	1932 lb.	1932 per cent.	1932 Increase or decrease of crop in lb.	1932 per cent. of improvement
No. 1	63,420	26	66,780	26.4	+ 3,360	.4
No. 2	42,180	17	59,400	23.2	+17,220	6.2
No. 3	133,980	57	126,000	50.4	— 7,980	7.4

Table 4.

Prices obtained and value of crop sold.

Grade	1931	1932
No. 1.	4s. per 60 lb.	4s. per 60 lb.
No. 2.	3s. 6d. ,,	3s. 6d. ,,
No. 3.	3s. ,,	3s. ,,
Total crop	£669, 7s. 6d.	£710, 17s. 10d.

A description of the ten varieties of North Nyasa rice had been attempted on a form modelled on Copeland, and it is hoped eventually to produce a monograph to be entitled *Rice in North Nyasa*. Determinations of varieties have not yet been made.

Experimental.

On both the Kasisi and Stevenson plots experiments were carried out in the Latin square arrangement on the statistical basis of Dr. Fisher.

At the former area only rice work was carried out and no cotton was planted as there would be no one available to supervise the experiments after the end of May. An extensive programme of work planned for the latter area was curtailed also.

Rice.—All ten varieties known to the main rice-growing area of the district were represented. Four of these were selected for trial under the two different methods of planting, namely, the normal method employed by the native of broadcasting and the nursery and transplanting method. The remaining six varieties were sown broadcast each in single elongated 1/80th-acre observation plots.

Seed stocks used were those obtained by the writer who carried out the necessary mass seed-selections in native cultivations. All varieties came true to type and further selections were carefully carried out again to provide seed for future experiment and work on varieties. The average seed-rate over all varieties in both broadcast and nursery methods of planting was 31 lb. of seed to the acre.

Nurseries were 1/40th the size of the area they supplied transplants for. A spacing of 12 inches by 6 inches was employed throughout all plots grown under the nursery method.

Plots for treatment by the broadcast method and nurseries to supply transplants were sown on December 8. Full healthy and vigorous stands of both treatments were obtained. Plants put out after thirty-two days in the nursery did not develop quite such good maximum growth as did the broadcasted sowings. It is considered that this was largely due to the short rain period of ten days following, as it did, almost immediately upon transplanting operations. From experience gained as a result of a close study of rice cultivation in North Nyasa, it would appear that to do full justice to the transplanting method of cultivation a more water-saturated and puddled condition of the soil than that normally available early in the season is an essential that can only be supplied by artificial irrigation. The flood notes mentioned in the rainfall table are of some importance and the following observation is made with reference thereto. The Lufira-Ngerenge-Tsongwe rice area to the north of Karonga is intersected by numerous streams and rivers which during the rains frequently come down in heavy spate, top their banks, and flood much of the country-side to depths varying from a few inches to several feet. It is by this natural seasonal form of irrigation, together with a high water table, that the rice crop of these areas benefits so greatly. The native rice cultivator is aware of this feature and not infrequently places his rice garden so that it may obtain major benefit from the inundations already referred to.

Conditions left little to be desired save for a short rain period in January. Monthly rainfall figures as recorded on the plot are included in table 5 below and these are representative of the rice area north of Karonga.

Table 5.

Month	Number of days on which rain fell	Rainfall in inches	Notes
November	5	6.47	Plots ready for seeding
December	15	16.36	8/12/32 seeded plot experiments (broadcast sowings and nurseries)
January	11	6.33	13/1/32 plots flooded (natural irrigation) by streams Kasisi and Nchowo
February	10	7.15	13/2/32 as in January above
March	13	15.59	23/3/32 as in two previous months
April	23	14.18	Total rice area thoroughly saturated and boggy
May	7	1.22	Ground still completely saturated.
Total	84	67.20	

In a method-of-planting trial the four treatments included the varieties *faya*, *msafili*, *mele* and *bungala mugeni* and these were arranged in two Latin squares. Plots were each 1/50th-acre and there were four replications of each treatment. The yield figures given below show significant differences in two varieties in the nursery method and no significant differences in the broadcasting method. The experiment should be repeated.

A. Nursery method.

Analysis of variance:

	Degrees of freedom	Sum of squares	Mean square	Log 10 $\frac{(\text{mean sq.})}{100}$
Rows	3	1,947	649	
Columns	3	414	104.6	
Treatments	3	1,684	561.3	0.749
Remainder	6	714	119	0.076
Total	15	4,759		

$Z = (.749 - .076) \times 1.152 = .673 \times 1.152 = 0.775$ with $n_1 = 3$ and $n_2 = 6$, z should exceed 0.7798 for the results to be significant with $P = 0.05$.

Since the results are so nearly significant it may be of interest to compare the treatment totals in the light of their standard error.

S.E. of yields of four plots $= \sqrt{119 \times 4} = 20 \times \sqrt{1.19} = 21.82$.

Treatment yields	Faya	Msafili	Mele	Bungala Mugeni	Mean	S. E
Grain per 4 treatment blocks	174	116	58	119	116.8	21.82
Grain lb. per acre	2,175.0	1,450.0	725.0	1,459.4	1,460.0	272.9
Grain per cent. of mean	149.0	99.5	49.7	102.0	100	18.7

To be significant (assuming the z test holds) differences in percentages must exceed $2\sqrt{2} \times$ S.E. $= 53.2$.

On this test *faya* is significantly better than *mele* but no other differences are significant.

Criterion of significance for $n = 6$, $P = 0.05$, $t = 2.447$

$$= t\sqrt{2} \times \text{S.E.}$$

$$= 2.447 \times 1.414 \times 18.7 = 64.8$$

Therefore, on this test *faya* and *mele* are the only two yields which are significantly different.

B. Broadcasting method.

Analysis of variance:

	Degrees of freedom	Sum of squares	Mean square	Log 10 $\frac{(\text{mean sq.})}{10}$
Rows	3	661.5	220.5	
Columns	3	329.5	109.8	
Treatments	3	485.5	161.8	1.209
Remainder	6	278.5	46.42	0.667
TOTAL	15	1,755.0		

$Z = (1.209 - .667) \times 1.152 = .542 \times 1.152 = 0.625$.

With $n_1 = 3$ and $n_2 = 6$, z should exceed 0.7798 for results of treatments to be significant with $P = .05$.

The results are therefore not significant.

The yields of grain in lb. per acre in the two experiments are as follows:

	Faya	Msafili	Mele	Bungala mugeni
1	2,175.0	1,450	725.0	1,487.5
2	2,187.5	1,825	1,525.0	1,762.5

Table 6.

Variety	Age in days	Computed acre yield unhulled rice in lb. (broadcast method)	Percentage unhulled rice to head	Percentage cleaned and sound rice to unhulled rice	Ease of threshing
Faya	158	2,188	92	42	very easy
Msafili	137	1,825	92	37	,, ,,
Bungala mugeni ...	134	1,513	87	44	,, ,,
Mele	125	1,525	85	34	,, ,,
Malulu	140	2,720	87	41	less easy
Bungala	148	2,960	90	45	slightly difficult
Maliya	148	4,240	91	46	very easy
Chimoto	148	2,880	88	43	less easy
Misi	140	4,000	90	46	very easy
Mwakilima	140	3,040	70	40	little difficult.

Table 6—contd.

Variety	Ease of hulling	Tendency to lodging	Tendency to shattering	Wt. 1 litre cleaned rice in grammes.
Faya	easy	none	slight	852
Msafili	very easy	,,	none	848
Bungala mugeni ...	,,	,,	slight	840
Mele	less easy	,,	none	844
Malulu	,,	,,	,,	848
Bungala	,,	,,	,,	852
Maliya	easy	slight	slight	848
Chimoto	,,	none	none	848
Misi	less easy	slight	slight	864
Mwakilima ...	difficult	present	none	848

Cotton.—In the annual report for 1931 the notes under this crop head did not make it sufficiently clear that, whilst planting in the ridge was employed with the summer sown crop in the Stevenson plots, planting on the flat was carried out in the winter sown crop in the Kasisi plots. A further year of planting operations has suggested that the method of planting at the latter area might well have predisposed to the low yields obtained. In this connection it is of interest to record that the native frequently elects to grow his late-planted cotton and other crops in huge mound-like ridges or *tsinde* which he constructs as the flood-waters subside. These *tsinde* have a base width of three to four feet and are two to three feet in height. At the end of the season these mounds are split and levelled in readiness for a crop of rice to be sown. This method of cultivation received a personal comment in a report of an *ulendo* which I made to the district in 1925.

The results from the various experiments carried out in the Stevenson plots follow:

Kaffir corn (Sorghum vulgare).—The varieties under trial were:

Lupira (*Sorghum caudatum*, Moench.) a selection from North Nyasa
Karonga ,, ,, ,, ,, ,, ,,
Mikota (*Sorghum guineense*, var. *involutum* Stapf.) ,, ,, South Nyasa
Mkomba (,, ,, ,,) ,, ,, ,,

Method of planting: single-plant stands planted in ridges spaced 4 ft. by 18 in.

Size of plots: 1/40th-acre.

Arrangement: Latin square with four replications of treatments.

Full vigorous stands were obtained throughout.

The superior yields obtained from the local Karonga variety and the variety *mikota* from South Nyasa are clearly indicated by statistical examination of the plot figures.

	Lupira	Karonga	Mikota	Mkomba
Total	30 ...	75 ...	69 ...	31
Mean	7.5 ...	18.75 ...	17.75 ...	7.75

These results are easily significant by the Z test.

Standard error of one plot 2.97 or 23.1 per cent. of the mean.

Significant difference between means (P= .01) =7.8

Maize.—The varieties represented in the method-of-cultivation experiment were *Potchefstroom Pearl* and the local Karonga variety.

Method of cultivation: Single plant stands spaced 4 feet by 15 inches in the ridge. Native method, i.e., planted on the flat at a spacing of 3 feet by 3 feet approximately with an average of three plants per hole.

Size of plots: 1/40th-acre.

The two varieties were planted to both methods and the treatments arranged in a Latin square were each four times replicated.

The results obtained were statistically examined and whilst they were found to be significant by the *Z* test the full value of the results is appreciably lessened by the fact that the ridged plots under *Potchefstroom Pearl* carried poorer stands than did the other three treatments.

	Karonga (ridged)	Potch. Pearl (ridged)	Karonga (native method)	Potch. Pearl (native method)
Total ...	236	164	295	254
Mean ...	59	41	73.75	63.5

Standard error of one plot = 5.8 or 9.8 per cent. of mean.
Significant difference between mean yields (P=.01)=15.2

It should be recorded that the *Potchefstroom Pearl* maize in ridge cultivation plots appeared to be more susceptible to an early and severe attack on seedling plants by a species of the family *Julidae*. It also suffered more severely than the others as a result of the heavy rains.

The issue of this experiment would appear to indicate that the native method of planting gives better results and also that the local variety of maize gives a superior yield to that of the imported variety.

Finger millet.—Three varieties were represented in the method-of-cultivation trial.

1. Kangumba, a short-age variety from South Nyasa
2. Mtanga, „ „ „ North Nyasa
3. Malesi, a long-age variety from North Nyasa

Method of planting: A. Nursery and transplanting. Spacing 2 feet by 6 inches.

B. Broadcasted after method of the North Nyasa native.

Size of plots: 1/100th-acre.

There were six replications of the six treatments which were arranged in the Latin square.

It will be seen from the figures obtained after statistical analysis that the results are very probably significant as the value for *Z* is just below the 1 per cent. point and it therefore can be taken that the short-age variety *kangumba* when sown by the broadcast method has superior yielding qualities over the varieties *malesi* and *mtanga* irrespective of whether the latter are broadcast sown or transplanted and that *kangumba* itself gives a better yield by the broadcast method of sowing than by the nursery and transplanting method.

	Kangumba (transplanted)	Kangumba (broadcast)	Malesi (transplanted)	Malesi (broadcast)	Mtanga (transplanted)	Mtanga (broadcast)
Total ...	51	80	72	56	61	60
Mean ...	8.5	13.67	12.0	9.67	10.17	10.0

In this experiment stands were both even and excellent throughout but in all treatments the crop suffered considerable loss due to the excessive rains which not only caused severe lodging but delayed harvesting as well. This is reflected in the average threshing percentage which is 54 per cent. for this season against 68 per cent. obtained last season.

Japanese barnyard millet (*Echinochloa frumentacea*).—The smut disease *Ustilago Panici-frumentacei* Bref. is prone to attack this plant and, as the result of a suggestion from the Mycologist, an effort was made to ascertain if a measure of control could be obtained. It was recommended that seed be treated by steeping in a solution of copper sulphate for ten minutes prior to sowing. The results obtained would indicate that the treatment is probably efficaceous. The low yields quoted below are attributable to an exceedingly heavy attack of the disease, control of which was aimed at in the experiment.

Method of seed treatment	Yield in lb. per acre
2 per cent. solution	250
4 „ „	250
untreated	200

Soya bean (*O-too-tan*) var.—An area was put under this crop for the purpose of seed multiplication and the satisfactory acre-yield rate of just over 900 lb. was returned.

Staff.

The nucleus of a district agricultural instructor field staff has been formed and trained to a very fair standard of efficiency. Their training has included a wide range of field work suitably augmented by periods of schooling and experience with direct responsibility on the experimental areas which represent as they do two distinct types of agricultural conditions of the lake-level

areas in North Nyasa. Mother necessity has provided for them an additional experience which with due training and supervision has proved their efficiency when dealing with invasions of the migratory locust. For a district the size of North Nyasa, 4,800 square miles, the staff is inadequate if more than a portion of the district is to receive any degree of intimacy with agricultural uplift and advancement.

Suitable field staff is not picked up readily and their training even to a small degree of efficiency also takes time. It is hoped therefore that before very long the much required training centre for native agricultural personnel may be instituted.

In conclusion, I wish to express my indebtedness to Mr. Leach, Mycologist, and to Mr. Hoyle, Assistant Cotton Specialist, for the assistance they have both given to me in connection with statistical examinations of the various results from field experiments as quoted in this report.

FRANK BARKER,
District Agricultural Officer.

Annexure C.

Report of the Assistant Director and Agricultural Chemist.

The work for the year 1932 can be divided into :—

1. Meteorological and soil investigations.
2. Supervision of field experiments and seed production.
3. Tobacco inspection and extension services
4. Crop observations.

I was absent on leave from April 21 till November 2.

1. Soil and Meteorological Investigations.

It is evidently necessary at this stage to point out that the lines of approach to useful investigations on climates and soils which have been initiated in Nyasaland during the past few years have been definitely approved at the conference of East African soil chemists held at Amani in 1932. Soil and rainfall maps are desirable for the proper development of many areas, but the methods of analysis must aim firstly at a classification which can be of assistance to agriculturists and certain administrative officers. Naturally there is a large interest in tropical soils displayed by numerous scientific bodies and there is also the likelihood of co-operative work on climatic soil types which may occur not only in Nyasaland but also in similar climatic zones of Rhodesia, India and China.

It is also necessary to impress upon many of our agriculturists the extremely limited value of the results obtained by certain methods of analysis. There is still a strong belief that the estimation of potash, phosphates and lime extracted by strong and dilute acids from a soil will indicate the need or otherwise of applications of certain fertilizers, even in areas where the distribution of important soil series and types is not known and on the soils of which no experiments of significance have been made, but this belief requires strong refutation.

The following notes will indicate the close relationship which surveys of climate and soil will have and silence the criticism that soil work should obtain results of immediate and great value to agriculturists in their crop and manurial problems without careful experimentation. Experiments must necessarily accompany work on soil series and types which cover large areas and their results should be of statistical significance. To clear up another matter which is often the subject of controversy, the following quotations are given to support the opinion of the writer. C. F. Marbut states, "The coincidence of soil belts and climate belts has caused soil students to conclude that climatic forces are the predominant soil-forming agencies of the world, obliterating or reducing to a subordinate position in relatively short time the influence of the parent rock material. In fact, in a study of the soils of a region, taking into consideration their broad general characteristics only, the influence of the parent material may be mainly neglected. This may be done with less and less risk of error as the climatic forces become more and more powerful." The Russian worker, Professor C. D. Glinka, says, "Is it, for instance, a matter of importance whether the soil is derived from granite, diorite or diabase? No, for researches in the field have shown that, under similar external conditions, all the above mentioned rocks give uniform soils, while on the other hand we know that, under the influence of dissimilar external factors, soils differing profoundly from one another may be produced from the same type of granite."

Soil.—Studies of the distribution of acidity in soil profiles were continued and samples of typical profiles of important soil series were forwarded to the Imperial Institute for certain examinations of mineral constituents and analysis of the clay fraction. It is maintained that such profiles should show a normal distribution of acidity. On plotting the pH values against depth at which the samples were taken, curves should be obtained as in accompanying graph (No. 1) and further work on the samples such as analysis of the clay fraction should not be attempted until such curves are obtained. Furthermore, it is found that there is a distinct relationship between the silica-alumina ratio in the clay fraction of soils from these typical profiles and the average annual rainfall under which the soils have been formed. In the case of certain immature soils and those in which the movement of subsoil water during the wet season is abnormal, the distribution of acidity and the composition of the important clay fraction are often abnormal. It will be understood that a large amount of seepage water will cause in certain localities or on certain slopes the formation of leached soils or will deposit certain compounds which in time form very abnormal soils.

The relationship between annual precipitation and composition of the clay fraction is seen on the accompanying graph (No. 2). It must be emphasized for soil work in Nyasaland that analysis of the clay fraction will give most useful information for characterizing series and types. The ratios of silica to alumina in the clay fractions of soils forwarded to the Imperial Institute were as follows :

Chimvua	2.72	...	2.66	...	2.87		
Namadzi valley	2.41	...	2.32	...			
Ahenga	2.0	...	2.0	...	2.03		
Mlanje-Swazi	1.48	...	1.40				

These fit very well in the graph as will be seen, corrected rainfalls having been obtained from planters in the vicinity such as at Ruo and Livingstonia. Further information obtained on exchangeable bases, etc., can await the publication of soil survey bulletins.

Work was continued on the problem of the supply of available sulphur in certain soils at Mlanje and Zomba. A description of such soils was supplied to Dr. Storey and Mr. Leach for their bulletin on the sulphur deficiency disease of tea.

Meteorological.—Books were kept up during my absence and there is now a large number of records from various districts which have been analysed for intensity and averages have been worked out for annual and monthly precipitation. There is still much to be done with the accumulated records. It is proposed to move all instruments to the Zomba Experimental Station in the near future on account of the unsuitability of the present site of the Stevenson screen and the prospective movement of the department to new offices. The records for two years on the two stations are available for comparison. A rainfall map of the Protectorate was forwarded to the Air Ministry in London.

2. Field Experiments and Seed Production.

Continued from the previous year, some interesting results were obtained from the field experiments in 1932.

The rotation and green manuring experiments gave the following results from randomized blocks, each treatment being replicated six times.

Yields of tobacco in sound green leaf in lb. from six 1/20 acre plots :

After tobacco	1,296
After maize	1,438
After velvet beans as green manure	1,244
After soya beans harvested	1,675
After sunnhemp as green manure	1,847

Accomodation available did not allow of this disease-free leaf being kept separate in curing.

Analysis of variance :

	Degrees of freedom	Sum of squares	Means square	Mean square log 100
Block	5 ...	15,618 ...	3,123.6	
Treatment	4 ...	43,672 ...	10,918 ...	1.03815
Remainder	20 ...	56,568 ...	2,828.4 ...	0.45155
Total ...	29 ...	115,858 ...	— ...	.57660

$$Z = .577 \times 1.15 = .664$$

To be significant Z should be greater then .5267 where P=0.05. Therefore the treatment differences are significant.

$$\text{Standard error} = \sqrt{2828.4} = 60\sqrt{4.714} = 130.27$$

Yields of tobacco on various plots :

A after velvet beans	B after continuous tobacco	C after maize	D after soya bean	E after sunnhemp	Means	Standard error
1,244 ...	1,296 ...	1,438 ...	1,675 ...	1,847 ...	1,500 ...	130.3
83.0 ...	86.4 ...	95.8 ...	111.6 ...	123 ...	100 ...	8.7

$$\text{Criterion of significance} = t\sqrt{2} \times 8.7 = 24.6$$

The yields of tobacco after velvet beans, tobacco and maize are not significantly different. The yield of tobacco after sunnhemp is significantly greater than the yields after velvet bean, after tobacco and after maize but not significantly greater than after soya beans. Yields of tobacco after soya beans are significantly greater than those after velvet beans or after tobacco but not significantly greater than after maize.

The yields of leaf tobacco which was free from disease and as far as possible of equal moisture content for three years in rotation experiments 1927-1932 are as follows. The tobacco was harvested and weighed 1928, 1930, and 1932.

Previous crop	Sunn hemp	Velvet beans	Continuous tobacco	Soya beans	Maize
Average yield ...	5,924 ...	5,479 ...	4,722 ...	6,740 ...	6,073
Number of plots dealt with ...	17 ...	18 ...	26 ...	17 ...	15

Further experiments in 1932 on manuring small grains with organic materials show that applications of cattle manure at the rate of 5 tons per acre give significantly greater yields with small grains than those obtained after application of cotton seed. Full results with the analysis of variance are given below.

Analysis of variance :

	Degrees of freedom	Sum of square	Mean square	Mean sq. log 10
Blocks	5 ...	177.0 ...	35.0 ...	
Treatments	4 ...	13.0 ...	3.25 ...	0.5119
Remainder	20 ...	22.2 ...	1.11 ...	0.0453
Total	29 ...	212.2		

$$Z = (.5119 - .0453) \times 1.152 = 0.5381$$

With $n_1 = 4$ and $n_2 = 20$, Z should exceed 0.527 for the results of treatments to be significant with P=0.05. The results are therefore significant. Standard error for the treatment total = 1.11 × 6 = 2.581

Treatment Yields	5 tons cattle manure	10 tons cattle manure	Rotted green manure	Control	Cotton seed	Mean	S. E.
Grain per 6 treatment plots	51.00	45.50	44.50	41.00	39.75	44.35	2.58
Grain % of mean	115.0	102.6	100.4	92.4	89.9	100	5.83

To be significant differences in percentages must exceed 2 √ 2 × S.E., i.e., 2 √2 × 5.83 = 16.5

The only significant treatment is the significantly greater yield with 5 tons of cattle manure over the control and the cotton seed. The 10 tons of cattle manure give a yield which is neither significantly less than the 5-tons treatment nor significantly greater than the control plots.

The total yields of straw plus grain from the various plots were as follows.

	5 tons cattle manure	10 tons cattle manure	Green manure	Control	Cotton seed
Per 1/5th acre	968	1,239	717	623	863

In further experiments with dark tobacco, it was again found impossible to obtain significant differences of leaf by varying applications of lime and phosphates. The results were as follows.

Treatment in lb./acre	Average yield in lb. per acre of g. leaf tobacco
Control	5,350
Lime at 2000 lb. and double superphosphate at 200 lb.	5,480
Lime at 2000 lb.	4,860
Double superphosphate at 200 lb.	5,350

Another experiment designed to study the effect of double superphosphate on the ripening of flue-cured tobacco gave no significant results on the period during which the various treated and untreated tobaccos ripened nor was there a difference in favour of the treatment.

A demonstration was also given with flue-cured tobacco which had been fertilized with different forms of lime and potash including wood ashes to indicate the small effect obtained with such applications.

A potash experiment was also carried out on dark tobacco, but no significant results were obtained. There seems an advantage in applying potash in the form of muriate or as wood-ashes to dark tobacco soils rather than as sulphate or nitrate, other things being equal.

A further experiment with *Harrison Special* tobacco to study applications of magnesia and sulphur on soils on which tea exhibits during every dry season symptoms of sulphur deficiency gave no significant results. During the growing season under review few symptoms of magnesia and sulphur starvation were seen on any variety of tobacco.

In studying the form of nitrogen in which artificial fertilizers should be supplied to dark tobacco, there seems an advantage in deriving some of it from nitrate of potash and sulphate of ammonia over the practice of using other forms, but, unfortunately, the results did not possess statistical significance. The full results can await further experimentation.

An experiment was also commenced on a certain Mlanje soil type on which considerable expenditure on fertilizer had not prevented tea from suffering from sulphur deficiency. There is at present no evidence that certain sulphur compounds and sulphur itself will undergo oxidation or sulphofication by soil bacteria on these soils. The latter does not seem to give any benefit to the diseased tea after several months and has not affected the soil reaction with large applications.

Organic matter. The maintenance of organic matter in the soils of Nyasaland has been continually brought before agriculturists in soil survey and other bulletins. The preparation of *Adco* artificial manure and varying treatments of cattle manure have been often studied at the Zomba Experimental Station and elsewhere, but the method now largely adopted is the preparation of Indore compost on the lines of Howard and Wad by which the loss in various constituents of manure both liquid and solid is brought to a minimum.

Seed. Further work on the Western D.N. variety was continued accompanied by many leaf measurements of plants grown from bulk and from single-plant selections. Valuable assistance was given in this work by employees of the Native Tobacco Board. The results from the latter selections were plotted with good results.

Seed and plant issues. Whilst I was on leave 250 lb. of W.D.N. tobacco seed grown on the Zomba Experimental Station was issued for sale to growers in the Southern Province. This was all disinfected by Mr. Cormack to whom both in seed and all experimental work I am deeply indebted. The produce sold consisted of tobacco leaf, seed of green manure and cover crops, numerous plants of fodder crops and many free issues for trial in various parts of the country.

3. Inspection and Extension Work.

Co-operation with the Native Tobacco Board involved the selection of seed plants, demonstration with various fertilizers and the inspection of seed plants on estates from which supplies were purchased. A large stock of the latter is now maintained at Zomba and Lilongwe in the case of several of the seed plots being failures.

Capitaos and native growers received demonstrations on the Zomba station and carriers were recruited for work in the Northern Province.

Little work on ridge-terracing was done owing to my absence on leave but a new system of terracing accompanied by cover crops has been started on one large tea estate. It has been endeavoured always to multiply *Indigofera endecaphylla* in Nyasaland since I introduced the plant in 1927 as it is considered this is one of the best cover crops for tea and coffee. No harm has been done to coffee plots under this cover although little cultivation has been done to this coffee for many months. Some harm has doubtless been done to young tea at a certain stage but the cumulative effect can be nothing but good. The cultivation of parallel strips on the contour can be recommended with this cover crop leaving alternate strips about four feet wide to be dug over at intervals of about four months.

I read a paper of on *Fires, forests and farming in Nyasaland* at the Imperial Institute whilst on leave and have elaborated this into a bulletin on denudation and soil deterioration in Nyasaland.

I also visited some brokers and manufacturers in the U. K. to ascertain present position of and demand for Nyasaland tobacco types.

I have suggested to the Nyasaland Tobacco Association that a committee should be formed to go thoroughly into the question of the management of flue-cured tobacco soils.

The monthly crop and market report was compiled by me whilst I was in Zomba and I endeavoured to give notes of topical interest on weather, manuring and disease on various crops.

The proper use of organic materials in a manuring programme has been put before growers of various crops and I gave a lecture upon this problem and the acidity of tea soils to the Tea Research Association in April. Several tons of groundnut cake were also purchased from a soap factory for demonstration to native tobacco growers under the supervision of the Native Tobacco Board.

Note on chlorides in Nyasaland tobacco.

It is as well here to review the supply of potash to the tobacco plant in Nyasaland. The following table is reproduced from a paper on *Weather and Tobacco in Nyasaland* (7), from the *Bulletin of the Imperial Institute* and further analyses by ourselves.

D = darks, B = flue-cured bright tobacco

Year	Locality and type		Seasonal Rainfall	Percentage in dry leaf			Potash-chlorine ratio	Lime-magnesia ratio
				Potash	Chlorine	Lime		
1909	Midima	B	36	4.80	.64	2.76	7.5	3.1
1909	Midima	B	36	2.01	.19	3.20	10.4	3.9
1909	Mlanje	B	69	3.11	.03	2.56	104	3.0
1916	Likangala	B	30.29	3.80	.20	3.4	19	4.0
	,,	B	,,	7.10	.45	3.9	16	3.0
	,,	B	,,	3.60	.10	2.8	36	4.2
	,,	B	,,	4.80	.19	3.90	25	3.9
1917	,,	B	35.68	5.50	.22	3.90	25	3.2
	,,	B	,,	5.17	.31	3.64	16.6	2.9
	..	B	,,	5.27	.13	3.47	40.6	3.0
	,,	B	,,	5.22	.21	4.20	25	3.2
	,,	B	,,	4.60	.25	4.10	18.4	3.4
1922	Nswadzi	B	29.53	2.78	.23	3.10	12	2.1
	,,	B	,,	2.62	.28	3.42	9.4	2.5
	,,	B	,,	3.00	.23	3.12	13	2.1
	,,	B	,,	3.16	.33	2.86	9.6	2.1
	Likangala	D	19.32	...	.64	4.10	...	7.7
	Cholo	B	29.53	2.50	.64	3.18	3.9	1.8
	,,	B	,,	2.58	.46	3.19	5.6	2.3
	,,	B	,,	3.82	.37	2.91	10.3	2.0
	,,	B	,,	2.87	.40	2.99	7.4	2.2
	,,	B	,,	3.05	.26	2.92	11.7	2.2
	,,	B	,,	2.81	.26	2.92	10.8	2.4
	Nswadzi	B	29.53	3.49	.32	3.62	11	3.3
	,,	B	,,	3.12	.24	3.33	13	3.0
	Zomba Rd.	D	,,	4.25	.27	3.89	15.7	3.2
1923	Likangala	D	44.64	6.13	.31	3.42	19.8	4.4
	Cholo	D	45.64	...	.20	2.00	...	3.9
	Likangala	D	44.64	...	.60	3.74	...	3.6
	Luchenza	D	34.64	...	1.32	3.68	...	5.3
1926	Vua	D	36.8	2.58	.49	2.75	5.3	3.4
	,,	D	36.8	3.14	.26	4.73	12.2	5.5
	Chimawa	B	51.16	4.86	.06	4.4	81	4.6
	,,	B	,,	4.06	.08	3.6	51	3.9
	,,	B	,,	3.61	.06	3.92	60	4.4
	,,	B	,,	3.45	.04	4.0	86	4.7
	Likangala	B	,,	4.3	.05	2.8	86	3.9
	Tuanjati	B	,,	3.53	.06	2.3	59	2.7
	Dedza	B	52.10	...	.50	1.75	...	2.2
1927	Likangala	D	46.30	2.86	.34	2.51	8.1	2.9
	,,	D	,,	2.98	.51	2.66	5.8	3.6
	,,	B	,,	3.89	.07	2.43	55	3.5
	,,	B	,,	2.98	.06	2.19	49	3.3
	,,	B	,,	3.15	.08	2.19	39	2.9
	,,	B	,,	4.17	.08	2.50	52	2.9
1928	Zomba Road	D	43.18	...	.65	5.69	...	4.5

It has been deduced that the potash-chlorine ratio varies within wide limits according to the rainfall encountered during growth, the form in which potash is supplied, the type of soil on which the tobacco is grown, and the length of the period which is taken during ripening. The variety again is a factor.

The average analyses of tobacco from America have long been known. Examples may here be given.

Percentage in dry leaf.

	Potash K_2O	Lime CaO	Magnesia MgO	Chlorine Cl	Sulphur SO_3	Ratio of potash to chlorine
Virginia sun-cured	4.9	4.54	1.13	2.0	.72	2.45
Virginia flue-cured	4.6	6.42	2.00	1.95	.74	2.36
Clarksville fire-cured	6.4	7.00	2.30	.51	1.20	12.55
Kentucky air-cured	8.65	8.70	1.15	.40	.99	21.6
German leaf	4.99	6.19	1.26	1.15	1.04	4.34

It is evident from these tables, as has long been pointed out (2), that Nyasaland tobacco is low as compared with other tobaccos in its content of chlorine, lime and magnesia, and generally high in its ratio potash-chlorine except in seasons much drier than normal. The valuable work on the intake of chlorine by the tobacco plant by Dr. Arnold has since been published (8) and bears out our recommendations made for the Thorneycroft scheme and to Zomba planters since 1926. The water-soluble chlorine in Nyasaland soils is always very low and the exchangeable lime and magnesia are also low.

Efforts must be made generally by flue-cured tobacco growers to bring up the composition of their tobacco to that of American leaf by correct applications of lime, magnesia and chlorine.

The general application recommended to the Zomba planters in 1926 (4) was in the following proportions, rates of application varying for different soils,

double superphosphate	100
muriate of potash	50
sulphate of potash	50
sulphate of ammonia	50

and has given good results. It might be now altered so that more chlorine is derived from the muriate or other sources and more magnesia might be applied in organic materials or magnesian lime at some point in the rotation to be determined for various soil types. It must be realized that chlorine present in applications of muriate of potash and other chlorides is removed very rapidly during the heavy rains often encountered at the beginning of the season so that some chlorine should be derived from organic materials in the manuring programme.

4. Crop Observations.

The diseases which have attacked tobacco during the past eleven years may be reviewed here. These notes should not be out of place considering the time I have spent in the field and the extensive study I made of tobacco diseases in the United States (3).

In the first place several major factors have been operative during late years in minimising the incidence of serious diseases. The large part which dark tobacco now plays in the total production has been noted and it is a fact that this dark tobacco is mainly grown from the Western Dark Nyasa variety which has been acclimatized for some years and has been under careful observation under all sorts of conditions since the first plants were selected in 1926 from a mixed lot of Kentucky origin. The variety must be said to be strongly resistant to many diseases and it remains particularly free on the Zomba station. Furthermore, during the past year in the Southern Province disinfection of all seed issued through the district commissioners was carried out.

Most of the dark tobacco in Nyasaland is now grown away from the hill regions and can be said to grow generally under seasonal conditions which promote rapid and unbroken growth generally held to produce good yield of the best quality. A mountain climate in contradistinction is often characterized by a large range in temperature from day to day and by spells of sunless and misty weather which are sometimes conducive to several checks in growth and susceptibility to diseases of various kinds.

Bacterial and virus diseases are most to be feared but happily from many causes the former have caused decreasing damage of late years in Nyasaland. They reached their highest incidence in the years 1923, 1926, and 1929. Angular spot caused by *Bacterium angulatum* or a similar bacterial disease has caused losses of sixty per cent. in a crop in some years but wildfire caused by *Bacterium tabacum* has rarely been seen, and was last seen in 1926 on plants grown from recently imported seed which had not been disinfected, and in nurseries which had not been sprayed with Bordeaux mixture.

It is certain that the latter measures of control which have been strongly advocated by the department since 1922 are not only conducive to freedom from bacterial disease but also help in minimising damage from the frog-eye spot caused by *Cercospora nicotianae*.

The virus diseases of tobacco which have existed in Nyasaland for the past ten years are mosaic, ringspot and cabbaging. The virus of cabbaging or leaf-curl has been shewn in Java and at Amani to be transmitted by a whitefly and the opinion is still held, as in Java, that certain soil conditions cause the tobacco plant to exhibit more severe crinkling, shortening of internodes, and thickening of the smaller veins on the the lower surface of the leaf. There are three distinct types of cabbaging. It was obvious during the season 1931/32 that the infection could take place at all stages of grwoth and that, if a few plants were infected at a late stage in the field, loss was very slight as a rule. Nursery infection is more serious and may lead as in certain areas of Luchenza year after year to considerable loss in the field. The number of whitefly concerned also determines the extent of damage. Indigenous plants of a shrubby nature such as *fusa* (*Vernonia* spp.) seem to be most susceptible in the Southern Province and these exist in large numbers in land which has been cleared, exhausted and then abandoned. The *fusa* weed is comparatively rare in the tobacco areas of the Northern Province but I was surprised to find whitefly in numbers feeding in numerous plants of the undergrowth there and such plants as *chipulutunzi*, *chitembe* and *mitola* must come under strong suspicion and even zinnias and hollyhocks are found with cabbaging. It is quite possible that cabbaging may cause serious loss in these important dark tobacco areas. Care should obviously be taken in the destruction of old stalks in the field by burning and in clearing an area round fields and particularly nurseries. The loss from cabbaging on the Zomba Experimental Station usually amounts to about three plants in five acres and this may be due to the greater sanitation practised and the large area cleared round nurseries. That whitefly is present in numbers on numerous crops there has been reported by the Entomologist. Doubtless also spraying which must be considered by the large grower helps in minimising the occurrence of infective whitefly. True frenching which must not be confused with cabbaging is very rare in Nyasaland.

Mosaic disease of tobacco is capable of doing far more damage than is usually realized and the white specking which is a symptom besides the mottling and blistering of the leaves may be easily confused with other leaf disease. The prevalence of mosaic in certain areas year by year requires explanation.

They may be a connection between the severity of the symptoms and soil conditions which is worthy of field experiment. This is now being carried out at Makwapala. No doubt if mosaic is noticed on young plants the transmission of the virus at planting, suckering and topping time may be considerably reduced by workers washing their hands with soap and water at the end of each completed row.

Ringspot was prevalent during the season 1931-32 although little is seen in most years. The primary lesions were subsequently made worse by invasions of saprophytic fungi and it is quite likely that a *Phyllosticta* fungus in combination caused whole portions of the leaf to rot and fall away to powder which is a more serious aspect of this disease. It is doubtful if the *Phyllosticta* is highly parasitic. It is worthy of note that ringspot has been observed at its worst in 1927 and 1932, which were two comparatively good seasons.

To turn to fungi which have often been found on dead and decaying tobacco leaves and which have been identified as species of *Alternaria* and *Macrosporium*, it is evident that much work is required on the parasitism of these organisms. There is, in view of other factors associated with the growth of the tobacco plants concerned, a tendency to regard these organisms as being merely saprophytic and that they grow upon tissue which has been weakened through physiological causes, root gall-worm or by the inroads of bacterial leaf spot (3).

Frog-eye or *Cercospora* leaf-spot previously referred to is undoubtedly the most serious disease met with on flue-cured tobacco in Nyasaland although of minor importance on dark tobacco. It is capable not only of causing the characteristic brown spot with white centre on lower leaves but of rapidly infecting upper leaves in wet weather and also causing spots to develop in the barn on what looks initially like clean leaf. The advantage of thorough and early priming is now well known to all growers but it may again be necessary to remind growers that the *Cercospora* grows most readily on tissue of ripe leaf and that therefore leaf, if infection is present, should not be allowed to remain too long in the field beyond a certain stage of ripeness.

Methods of minimising damage to infected leaf in the barn have been advocated since 1923 (1) and have been adopted in this country and in Rhodesia. The sapping method consists of raising the barn to 90 deg. Fahr. as soon as it is full of leaf. After three hours, this temperature is raised to 125 deg. Fahr. After a few minutes the temperature is allowed to fall to 90 deg. again. The ordinary yellowing process is then continued. Controversy has arisen as to the effect this has upon the leaf and the organism, but it has not yet been proved that the organism is killed or checked by the sudden rise in temperature of forty degrees or so. It is most probable, as Hopkins points out (6), that the invaded cells are killed and the organism remains in a dormant condition. It is a fact of course that leaf in which the enzymes are destroyed by heat or protoplasmic poisons will not cure.

Another method is to allow the barn to reach a temperature of 95 deg. as registered by a thermometer suspended over the middle of a flue. The temperature is retained only six hours and then, at about six-hour intervals, the temperature is increased by 5 deg. till 110 deg. F. is reached. A low moisture content is obtained which reduces the spotting to small proportions but care must be taken that too much green is not obtained by too rapid a drying.

It must be noted, however, that wilting of leaf is generally conducive to the development of much spotting in certain infected leaf.

Mildew or white mould caused by *Erysiphe cichoracearum* is now comparatively rare on tobacco grown at the average elevation and under the average climatic conditions of Nyasaland. It was noticed on a susceptible variety, *Hickory Pryor*, in 1926 and also broke out on late tobacco in April 1928 during a sudden cold snap, but only a few isolated plants have been observed since. Blue mould caused by *Peronospora hyoscyami* has not been found in Nyasaland.

Hollow-stalk or pith rot caused by *Bacterium carotovorus* and *B. aroideae* is fairly common in some wet seasons being doubtless carried by workers topping and suckering. It has occurred on the Zomba plots on seed plants which have never been topped. Prevention largely consists in field operations only taking place in fine weather and, if hollow stalk occurs anywhere, in workers washing their hands at the end of rows with soap or a disinfectant such as potassium permanganate in a ten per cent. solution. This latter method proved very efficacious in 1928 and 1929. The organisms causing hollow-stalk have also been found to attack quite young plants from nurseries in the Liwonde district. This has necessitated frequent re-planting but in no case has the disease destroyed whole fields. The use of knives in topping has also been found to minimise the disease and removal of isolated plants also helps.

This slimy rot of the pith which is also capable of doing considerable damage in barns which have been filled with infected leaf has become popularly known as stem-rot in Nyasaland. This is unfortunate, as stem-rot is usually restricted to those diseases caused by *Rhizoctonia solani*, *Sclerotium rolfsii* and *Pythium* species, isolated examples of which are seen during some years. The latter may arise from the nursery and give the "sore-shin" effect in the field. Plants attacked with hollow-stalk may still be found to give good leaf but they should not be mixed with sound leaf as severe cases of *pole burn* may be started. It is better to air-cure such leaves with ample ventilation.

There was a serious outbreak in 1927-28 on ferruginous red loams with poor drainage of a disease which had all the characteristic symptoms of the black-shank of Florida. Fields were apparently planted with disease-free plants, and it was only when the plants had reached a considerable size that the symptoms were observed. A few plants were seen attacked with a very similar disease the previous year on fields where the disease was serious, and it seems that the original infection came from a nursery on one estate from which plants had been obtained for the fields in question in 1925 and 1926.

The loss in this drier season of 1928 reached serious dimensions, and the serious loss in Florida from a disease caused by a very similar organism had been seen and studied there so that the methods of control similar to those in Florida were the only ones possible. Isolated plants in many districts have been found to exhibit similar symptoms of black decay near the base of the stalk and in such cases the pith is often cut up into a number of discs. Dr. Butler found some of these attacked by *Pythium aphanidermatum* and named the disease black stem-rot, but the presence of black shank caused by *Phytophthora parasitica nicotianae* has been confirmed in Nyasaland. This was most probably the serious disease present on the ferruginous red loams in 1928 which, happily to relate, was practically stamped out by abandonment of suspected fields and nurseries for some years. In such areas as well the use of tobacco scrap or stalks as manure cannot be too strongly deprecated.

Granville wilt caused by *Bacterium solanacearum* has been seen in 1922 in Nyasaland but the loss then was negligible and the disease as far as is known has not recurred. A typical wilt of tobacco occurs in the United States which is caused by *Fusarium oxysporum* var. *nicotianae*. A very similar organism is often found in Nyasaland on tobacco roots, but it is maintained that either true *Fusarium* wilt does not occur or the organism in Nyasaland is only slightly parasitic.

Root-rots, either black root-rot caused by *Thielavia basicola* or brown root-rot whose cause is not definitely established, have not been proved to occur in Nyasaland. "Death sports" in which a number of plants exhibit very poor or stunted growth although surrounded by well-grown plants, all of which have been fertilized, do occur but these areas are almost likely to be caused by some obscure deficiency rather than by a definite disease such as brown root-rot.

Root-knot caused by the gall-worm *Heterodera radicicola* occurs all over Nyasaland, and causes appreciable losses on many of the plots of the Zomba Experimental Station. It is still maintained that almost ninety per cent. of the infection of the roots occurs in the seed-beds and the organism is thence carried to the field. I have long advocated that transplants should be only a few weeks old when taken to the field. It is often possible in our experiments to obtain healthy plants which will grow well in the field when they have been six or seven weeks old, but later infection by the gall-worm has occurred and at ten weeks old it is often impossible to obtain good growth and this is invariably so on depleted soils such as one finds on continuous tobacco plots. Good fertilizing and manuring, however, make a large difference to transplants eight or nine weeks old which are slightly infected. These plants often grow to normal size although inspection of their roots after harvesting shows then a large amount of root-knot. Again a small amount of infection may, when certain soil conditions are met with, cause a characteristic "burn" on the leaves. The leaves tend to perish slightly at the tips and margins and at these points to have brown discolorations. Various fungi are found on these discolorations but cannot be called the primary cause.

Various forms of malnutrition of the tobacco plant occur in Nyasaland under certain weather and soil conditions. The symptons of sand-drown due to magnesia deficiency are well known and occurre over large areas in 1926, especially on *Hickory Pryor*. This was the wettest season on record in the Zomba district. Isolated plants are often seen with these symptoms.

Potash and phosphate starvation are sometimes seen on sandy soil but call here for no comment. Lime and sulphur starvation are rare but nitrogen starvation in various forms may be seen at all stages of growth on old land and on sandy soil.

A word may be said here about drought spotting of tobacco. It is to be seen on certain unkindly soils and on sandy soils when ripening takes place in dry months. The two cases may be considered separately. The unkindly soils referred to are those in which the supply of water to the plant varies within wide limits. A pan often causes water-logging at certain points and again as a whole they tend to dry out very quickly. They often exhibit concretions of iron and alumina compounds near the surface and are really abnormal soils which should not grow tobacco or which require special treatment for other crops.

On sandy soils at the end of the dry season, the soil water quickly tends to reach the point at which most plants wilt. Ripening tobacco may, instead of wilting strongly as this point is reached, exhibit other symptoms in those leaves which are becoming brittle and full of starch. The laminae commence to perish and the leaf margins are usually rolled downwards. It is not unusual for the reddish spots which develop between the large veins to run together. Leaves may soon become useless for harvesting.

It is found that the form in which potash is supplied to the plant has an influence on the amount of spotting or specking of tobacco on these soils and in general muriate of potash can be recommended as the sole source of potash in the fertilizing programme.

Macrosporium spp. and other fungi are often found in conjunction with these spots but must be neglected in any consideration of control as they are most likely to be mainly saprophytic. Any measure, as has been indicated, which tends to regulate the supply of water to the plant or to increase it in dry periods will help also in minimising injury.

Note on finger millet cultivation.

The part played by the crop finger millet (*Eleusine coracana*) in the agriculture and so-called shifting cultivation of some tribes in Nyasaland has aroused considerable interest lately and the following facts concerning its cultivation and the possibility of improving or eliminating altogether the burning system so largely practised in the Mombera district may be of use. The burning system is now well known and may be only briefly referred to. Comparatively early in the dry season loppings from tree and coppice growth are carried to the acre or so of virgin soil or of soil which has been rested a few years. This is the site of the garden for growing finger millet and other crops during the following season. The work continues till October, and, when the rains appear very near, the layers of branches, leaves, etc. which often reach a height of 30 inches are set fire to. The ashes when mixed with a little soil which can be so easily pulverized after the burning make an excellent seed-bed and good germination results after sowing with the first heavy rains. Weeding is reduced to a minimum. The system has many variations but it is conceded that there is a great wastage generally of timber resources and that soil erosion is accelerated by the extensive deforestation and the radical change in the structure of the soil and subsoil, especially of certain red loam types.

The varieties of finger millet as known in Mombera and with the Nyanja equivalent are as follows:—

Chamafuta	=	Kataya	(N)
Katuatua	=	Chikonondo	(N)
Makonde	=	Manga-wa-nkango	(N)
Chapata	=	Mulakalika	(N)
Ntanga	=	Ntanga	(N)
Kabubu	=	Kabubu	(N)

Zimbiri (N) is also a very fine variety similar to *kataya*. All these types are growing under greatly varying conditions on the Zomba station, and it is unlikely that there is any material difference in soil requirements or in removal of plant food elements by any one of these varieties. All the varieties are growing well on unburnt soil in only a medium state of fertility without fertilizer and the following method of cultivation should receive consideration in certain districts as an alternative to the extreme destruction of valuable timber resources.

(*a*) Small nursery beds should be burnt with rubbish and brushwood as in the case of tobacco seed-beds. In November or December seed of finger millet should be sown for trans-planting in the following January or February respectively. Seed-beds should be 30 feet long by 1 yard wide. Such a bed should plant out one half-acre. Weeding should be carried out if necessary.

(*b*) In dull cloudy weather plants should be pulled from the beds and conveyed to the prepared field. This field will have been well cultivated towards the end of the previous rainy season but *not burnt over* and at the time of planting out should be quite clean. Holes should be made with a light hoe 18 by 18 inches apart and only one plant should be placed in each hole; this spacing will facilitate weeding and hoeing. In certain areas some difficulty will be experienced by workers in planting and supplying in a weedy field in distinguishing between finger millet and *Eleusine* grass (*Eleusine indica* syn. *chigombe* (Y) *mphusa* (N)), but, if weeding is commenced when the plants are about four inches high, the latter may be distinguished and pulled out. The method above is practised with slight modifications by natives in the Southern Province and no objection can be seen to the burning of rubbish and small amounts of scrub growth. The nurseries may be placed in the middle of a field and the plants may go on to mounds on which maize and beans are also growing.

Kraal manure cannot be used in the cultivation of finger millet as it always introduces the weed *Eleusine indica* in quantity which is stronger than *E. coracana* and tends to choke it. Indore compost as manufactured on the lines of Howard and Wad can however be used as all weed seeds are killed in the process. Land which has been early cultivated so that weeds and grass have not seeded may be manured with this compost and a good yield obtained.

Our experiments quoted above have shown the value of green manuring such as digging in sunnhemp and in growing leguminous crops such as soya beans. The value is appreciated by certain tribes who have indefinite rotations of fallow, millet, beans and maize, millet, sorghum and groundnuts, varying with the elevation and rainfall, but it is considered that a proper use of the leguminous crops in the rotation might be easily demonstrated and a better system of millet cultivation initiated. Artificial fertilizers are of very little use in dealing with this crop but our experiments are continuing with such minerals as lime, phosphate and potash to estimate exactly what part ashes play in determining the good yields obtained in the burning system. It is most likely that the main effects of burning are in improving the physical condition of the soil and in partial sterilization effects.

To sum up, efforts should be directed to improving the agriculture of tribes who are destructive of large areas of timber for cultivating finger millet, pumpkins, etc. by defining better rotations which will maintain good yields without any burning of gardens, replacing finger millet by other cereals which are less exacting in soil requirements, and by education showing the value of compost heaps, green manuring and correct terracing which may replace indefinite mound cultivation.

References.

The following publications of the Department of Agriculture, Nyasaland, and of others have been referred to by number in this report.

1. D/A, *Annual Report*, 1923.
2. Hornby, *Tobacco Culture*, 1926. Bulletin No. 1, section 5.
3. Idem, section 14.
4. D/A, *Annual Report*, 1927.
5. Bulletins of Imperial Institute, 1912 and 1914.
6. Hopkins 1931, *Diseases of Tobacco in Southern Rhodesia.*
7. Hornby, 1929, *Weather and Tobacco in Nyasaland;* paper read at Conference of Empire Meteorologists.
8. Arnold 1933, *Occurrence of Chlorine in Tobacco.* Rhodesia Agric. Journ. XXX, No. 3.

Appendix I.

(A) Notes on Growth of Plants Recently Introduced at Zomba Experimental Station.

Glyricidia maculata ... Medium shade for tea and coffee. Grows very well and may be planted from nurseries. Leaves may be stripped for mulching and green manure. Not possible to propagate by cuttings.

Derris robusta, *Derris microphylla* } Similar to *Glyricidia*

Milletia oblata ... Medium shade for tea and coffee. Rather slow in growth.

Cytisus alba ... Medium shade. Susceptible to root gall-worm.

Leucaena glauca ... Low shade. Prolific and early seeder.

Ceiba pentandra (Eriodendron anfractuosum) Java kapok var. *Randu Kuning.* Good growth.

Ceratonia siliqua ... Locust bean tree. Must be planted at stake and is a vigorous grower.

Schinus molle ... Pepper tree. Vigorous grower but difficult to transplant. Suffers from defoliation through a fungus in dry season.

Aleurites fordii, *Aleurites montana* } Tung oil nut. Good germination; growing well. Probably many different types present. Very good growth. Seven feet high after one year in field.

Cajanus cajan New varieties from India and Hawaii. Very early maturing varieties gave a very little seed which was attacked by weevil. Red gram was a little better and Hawaiian varieties show promise.

A stem canker on one variety *E-M Tur No. 3* leading to breakage of stem was initiated most probably by a sucking insect (? mosquito bug).

Crotalaria spectabilis ... Was attacked badly by jassid but is showing greater promise on acclimatization. Is also a forage plant.

Crotalaria juncea vars.... Early maturing varieties of sunnhemp which show little promise owing to small growth. Seed readily.

Cassia didymobotrya
Clitoria cajanifolia
Desmodium cephalotes
Cassia tomentosa
} Hedge plants for ridge terraces, etc.

Albizzia lebbek
Albizzia odoratissima
} Shade tree.

Phormium tenax ... New Zealand flax from seed which took seven months to germinate. Shows promise as a fibre plant and may replace native fibres the removal of which from trees for string creates so much damage.

Boehmeria nivea ... China grass which grows very well.

Lupinus spp. ... Four species which at present show little promise. A wilt disease is often present.

Trifolium subterraneum
} No promise.

Medicago sativa ... Is showing greater promise with inoculation and liming.

Digitaria Penzii ... Woolly finger grass. A very promising pasture and fodder grass which keeps very green through dry season.

Elaeis guineensis ... Nigerian oil palm which has only just germinated.

Zea mays ... *Hickory King* which yields very well. *Potchefstroom Pearl* seed from South Africa and Rhodesia gave very good types with large yield.

Setaria italica ... A variety obtained from U. S. A. which is superior to local types.

Coffea robusta Suffered from a chlorosis for a time during the dry season especially where tea suffered from *yellows* or sulphur deficiency. *Rhizoctonia* disease also present. Is now better.

Desmodium tortuosum ... Florida beggar weed which is improving by acclimatization.

Desmodium gyroides ... This medium shade and hedge plant grows well and is easily grown from seed and cuttings. A few individuals died towards the end of the dry season and on examination were found to be infected on the roots with the A strain of *Rhizoctonia bataticola* which is the fungus described from Uganda as *Rhiz. lamellifera.* (n.sp.). Other individuals remained perfectly healthy and it is difficult to suggest soil conditions or other environmental factor inducing the root disease.

Camellia Thea ... Some plots of Assam and Nyasa jat were grown. These also suffered from *Rhizoctonia bataticola* (*? R. lamellifera*) even where fertilized with cattle manure and sulphur compounds. Considerable recovery occurred with the advent of the main rains.

Dunbaria heynei ... Cover crop similar in vigour of growth to Vigna (*Dolichos Hosei*) Rather slow to start with.

Pueraria phaseoloides
Centrosema pubescens
} Cover crops of some promise.

Pueraria javanica ... Is superior to above but inferior to *Calopogonium mucunoides.*

Solanum tuberosum vars. *Up-to-date* and *King of Earlies* which did not do well.

Coleus spp. ... Rather slow in growth.

Zingiber officinale ... Is doing well.

Helianthus tuberosus ... Is doing well.

Phaseolus vulgaris ... Haricot beans of various types introduced from Kew gave fair results when late planted but the seed suffered heavily from weevil. It is generally necessary to plant these beans early at an elevation of 3,000 feet or so.

Avena sativa ... Varieties from Southern Rhodesia. *Kherson* does well and is better than our standard.

English grasses such as rye and cocksfoot, also crested wheat grass from Canada, show no promise.

Glycine max ... *Herman yellow* is a more attractive bean but shatters more easily than the long acclimatized *O-too-tan* and *Biloxi.*

(B) Varieties of Cereal Crops grown by natives in Nyasaland under observation.

Sorghum spp. ...	dembera	kapiri	kabiliwiri	
	mapira	sumbwi	itwakwenyao	(Anguru)
	namuze	misali		
	nunkho	chipwepweti		
Pennisetum ...	Transvaal			
	machewere			
	nachacha			
Setaria italica ...	koti-koti (2 types)			
	Tennessee			
Eleusine coracana ...	malesi	chikonondo		
	ntanga	manga-wa-nkango		
	kangumba	mulakalika		
		zimbiri		
Panicum miliaceum ...	nkwanje			
Echinochloa frumentacea	chindumba			

(C) Leguminous Crops grown by natives under observation.

Dolichos lablab	nkungudzu (four types, black, red, white and brown-seeded).
Vigna catjang ...	nseula, nkobwe
	Bushy and trailing

(D) The following Leguminous species have been either abandoned or are not recommended for further trial or for issue to planters.

Adenanthera pavonina	
Astragalus sinicus	
Canavalia gladiata	
Mimosa pudica	
Pueraria thunbergiana ...	kudzu vine.
Stizolobium deeringianum	
Cicer arietinum ...	Chick pea.
Lentils and Hubam clover	

Appendix II.

Yields from Zomba Experimental Station in 1932.

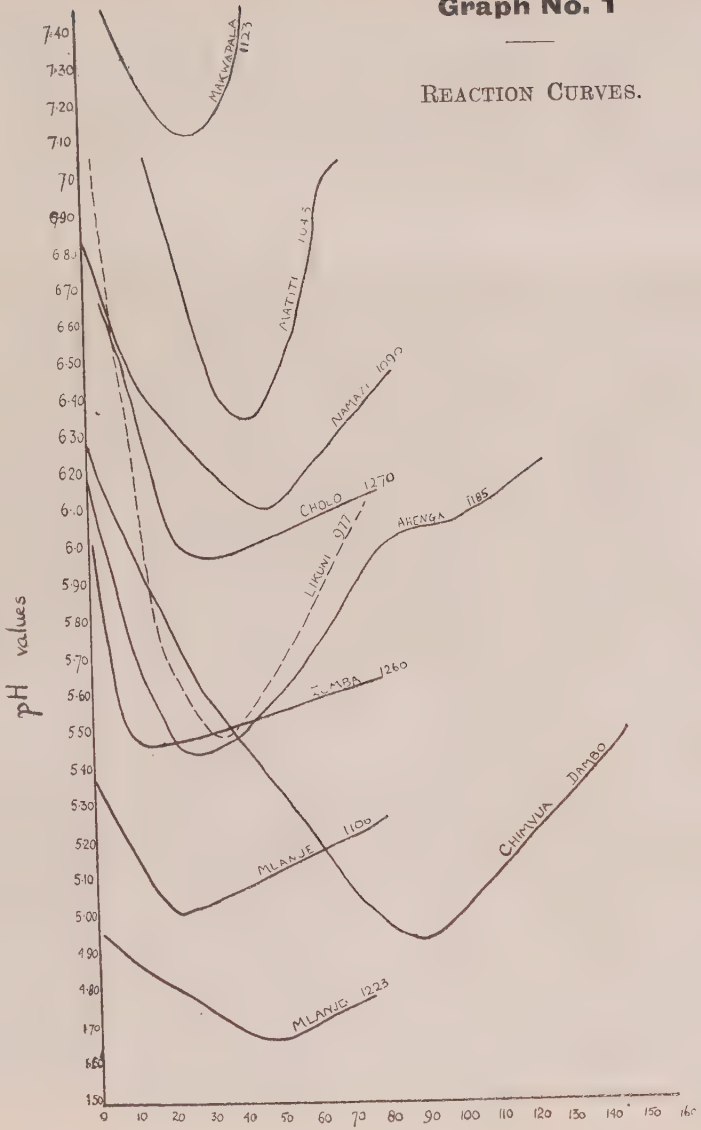
	Seed in lb. per acre
Coffee	277
Maize	961
Velvet beans	1,270
Tepary beans	1,280
Pigeon pea	865
Sunnhemp	436
Groundnuts	750
Buckwheat	557
Oats	908
Soya beans: miscellaneous varieties	1,191
Lima and other beans	666
Sunflower	1,120
Rice varieties	860
Also tobacco leaf	475
Tobacco seed	16½

There were also grown cassava varieties, banana, sweet potato varieties and introduced plants mentioned in Appendix 1 of my annual report for 1931.

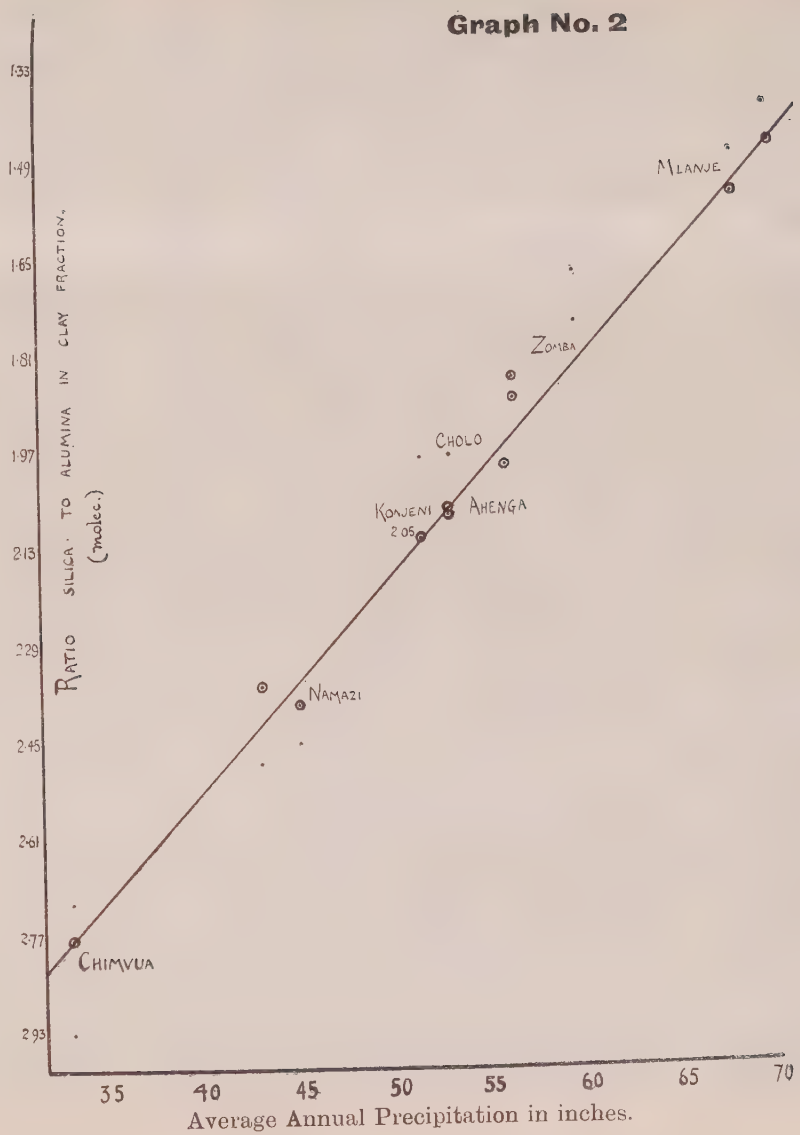
A. J. W. Hornby,
Assistant Director and Agricultural Chemist.

Graph No. 1

REACTION CURVES.



Graph No. 2



Report of the Entomologist.

The year 1932 will be memorable in the history of the Protectorate for the reason that, after a period of more than twenty years' freedom, the country was once again invaded by locusts. During the early part of the year some extra routine work was carried out in the absence of the Assistant Director of Agriculture on leave.

Locusts.

As was foreshadowed in the last annual report, it was considered to be only a matter of time before locusts invaded Nyasaland, from Tanganyika Territory to the north or from North-Eastern Rhodesia to the west. On January 24th and 25th the first flying swarms of the hairy-chested ocust, (*L. migratorioides*, R. and F.,) crossed the Songwe river from Tanganyika Territory in the vicinity of Ipenza. Some egg-lying took place at once and hoppers were present by February 19th and 20th. Prompt measures, possibly coupled with adverse weather conditions, rendered further development from this invasion innocuous and the damage to native crops incurred was comparatively negligible. On March 6th and 7th larger swarms of the same species of locusts crossed the Songwe river at almost identically the same spot as the previous swarms had done. These, however, passed rapidly through the narrow strip of Nyasaland territory into North-Eastern Rhodesia, via Nyimbo hill, by March 8th, without oviposition or doing any damage worth recording. On about March 19th a flying swarm entered the Protectorate from North-Eastern Rhodesia, some distance south of Fort Hill, but took first a north-westerly direction returning towards the Songwe river and then veered west, passing back again into Rhodesia some five days later. During the next five months only two small and sexually immature swarms of this locust entered the country, both in the North Nyasa district. On July 28th a swarm settled on the Rufira river between Ngerenge and the lake. Its movement tended to be south-westerly, probably influenced by the prevailing diurnal winds, and by August 13th it was reported to be near the north-eastern Rhodesia border to the west of Ntaliri. Further trace of this swarm was completely lost. At the end of August a further swarm crossed the Songwe river, again at the north-west corner of the Protectorate, but by September 14th this portion of the North Nyasa district was reported to be free of flying swarms and no further egg-laying had occurred.

From the available information it was obvious that these flights were merely the fringe of a general southerly movement from Tanganyika Territory, and with neighbouring countries both east and west of Nyasaland being invaded by flying swarms, as well as the extensive breeding taking place to the north of the lake, it was apparent that future developments would be of a very different category.

Somewhat unexpectedly, the first large migratory flights of *L. migratorioides*, R. and F., entered the Protectorate on about August 26th at the south-east end of Lake Nyasa, from Portuguese East Africa. It was not known until sometime later that large flying swarms had been moving south from the Rovuma river. Owing to most of these flights breaking up soon after arriving in the country, it is difficult to make an accurate statement as to the number of swarms that were involved. It seems clear, however, that the invasion continued on and off all through September and in all probability some five to seven distinct flights were concerned. During October reports from Fort Johnston (South Nyasa district) did not indicate that any large swarms were observed crossing the international boundary and early in November information was obtained from the Portuguese authorities that no more migrating swarms were to be recorded in that territory.

The first flying swarm, or concentration of swarms, that arrived at Kwizimbe, 24 miles north of Namwera, on August 26th appears to have been quite definitely in the process of a migratory flight, as its rapid movement seems to prove. This swarm rested on the evening of September 7th, on approximately a ten-mile front, on the Makungwa ridge to the north-east of Liwonde. The next day, September 8th, aided to some extent by a strong wind in the same direction, it travelled 40 to 50 miles southwards before the day's movement ceased between 4.0 and 5.0 p.m. at Ntondwe and the Saone section of the Magomero Estates in the Zomba district. The movement on September 9th brought this swarm to the escarpment dividing the Cholo (hilly) and the Chikwawa (Shire river valley) districts, passing to the south-east of Blantyre. Although a certain amount of dispersion of the swarm had been occurring during this prolonged flight, it was at this point that a considerable break up occurred and circling flights of smaller swarms commenced. A portion of the original swarm, however, moved still further south and south-easterly down the Shire river valley, reached Chiromo by September 14th and had crossed the international boundary in the vicinity of Chaka village towards the Zambezi valley in Portuguese territory by September 18th. By October 6th it was possible to report that the Port Herald and Chiromo areas were clear of flying swarms and that only small isolated groups remained in certain sections of the Chikwawa district, mainly on the line of the foot hills between Mwampanzi and Maperera and the Mwanza area.

A second large migrating swarm entered the country on the same line during September 7th and 8th. This followed the line of the Shire river southwards to beyond Blantyre and then, on breaking up, part of it reached the higher land of the Cholo district.

Further invasion from the same direction occurred during the month, notably on September 11th, 23rd, 25th and 30th. In these cases, however, the swarms were making circling flights and rapidly breaking up. A north-westerly movement commenced so that Ncheu (Mpamadzi Estate) was reached on October 8th and again on October 11th. By this time accurate observation on the

movement of the flying swarms had become extremely difficult and the reports became conflicting. In addition, a northerly movement of locusts in Portuguese territory to the west of Nyasaland resulted in flying swarms entering the Protectorate at the source of the Diampwe river on about October 13th and following the line of the Dzalanyama mountain range in a north-westerly direction for some distance. These may have been responsible for a swarm, notified by a single report as being in the vicinity of the Likasi river, between the Namitete and Bua rivers, on October 20th. A further complication was that two swarms appear to have crossed Lake Nyasa on September 27th from the east to Kota Kota and Domira Bay on the west shore. These proceeded inland, and coupled with the swarms from the south, were responsible for a scattered invasion of the Dedza, Dowa and Lilongwe districts. No further swarms were reported as entering these districts after October and it appears that the northerly movement had by then come to an end. On the other hand, during October and November there was continuous southerly movement of swarms from Fort Johnston to Liwonde and along the line of the Shire river.

Reports of copulation and egg-lying taking place were received early in November and the occurrence of the former was personally observed on November 11th in a small scattered swarm between Zomba and Liwonde, and again on November 17th in a very large swarm at Fort Johnston. It is of interest to record that locusts collected and caged by Dr. W. A. Lamborn on September 11th and 14th, paired on the 22nd and egg masses were found by September 28th. Eggs were first found in the field, however, on November 26th at Namalombe, some 20 miles north of Liwonde and to the west of the Shire river. Native reports intimated that egg-laying had taken place on November 23rd, but as hoppers hatched in this area on December 2nd the true date of oviposition must have been somewhat earlier. Reports of the discovery of hoppers rapidly followed one another during early December and it became apparent that areas over which eggs had been laid, even though known to the natives, had not been reported. By the middle of December there were large numbers of hopper swarms varying greatly in size, dispersed over a fairly wide stretch of country from the south end of Lake Nyasa to Kambalame near the crossing of the Blantyre-Salisbury road and the Shire river, with main concentrations in the Balaka station area and the Shire, Rivi-rivi, and Lisungwe river valleys.

Apparently no egg-lying took place in the Chikwawa and Lower River districts by the first swarms that passed right through the Protectorate in September. Similarly there was no further development reported during 1932 of the scattered swarms that had moved north as far as the Lilongwe district. (It is necessary, however, to include in this annual report the information that, after the invasion of this district by the red-winged locust, *Nomadacris septemfasciata*, Serv., in January 1933, the hopper swarms of this locust contained also hoppers of *L. migratorioides*, which may have been the offspring of stray adults remaining since 1932, though it is more likely that the red-winged swarms contained some hairy-chested adults.)

Adults developing from the hopper swarms were first observed at Fort Johnston on December 26th, but new flying swarms did not appear as such until the next month.

The North Nyasa district has not been included in the above review as the re-invasion here by *L. migratorioides*, although occurring at the same time as that described, confined itself entirely to this district. Native reports indicated that a swarm of some size crossed the lake on September 17th from the direction of Manda on the east shore to the vicinity of Deep Bay on the west. It was not, however, until November 21st that really large flying swarms from Tanganyika Territory commenced to cross the Songwe river, following the line of the lake shore. Two more of these flights arrived on November 26th and 30th, again on December 9th and 14th, and possibly some unrecorded ones occured as well. On December 3rd a small swarm crossed the lake from east to west, reaching Kayuni. On December 11th one more swarm was known to have crossed the Songwe in the north-west corner of the district and it seems possible that this swarm reached the lake shore by the end of the month.

Egg-laying by the majority of these swarms took place almost immediately over very wide areas and by the middle of December hopper swarms were extremely numerous, reaching from the Songwe river to Florence Bay and from the lake shore to the foothills. The Mwaya-Ipiana plain on the north side of the Songwe river was also heavily infested and hopper bands even crossed the river into Nyasaland.

From the outset of the locust invasion it was manifestly obvious that any extensive campaign of extermination would be impossible and financially uneconomical. Consequently combating measures were limited to mechanical means of destruction of hopper swarms in the vicinity of crops. In the most densely infested areas, the South Nyasa and Upper Shire districts, three Europeans and extra native police were employed in organizing the native labour in carrying out these measures. Elsewhere the work was perfomed by the district administrative staff. The action taken proved successful to the extent that the number of locally-bred flying swarms of *L. migratorioides* was very much less than would have otherwise been the case, most of them developing in forest reserves or uninhabited tracts of country where destruction of hopper swarms had not been possible. The damage incurred to food-crops by this invasion of locusts was, in reality, very slight. In the case of the original flying swarms, at the time of their arrival in the Protectorate the planting season had not commenced and only occasional *dimba* crops of maize suffered attack, together with bananas. On the development of the hopper swarms, the food crops were small and in many of the gardens which were invaded the plants were able to make fresh growth. Some gardens were destroyed beyond hope of recovery, as was only to be expected, and as time went on the increasing apathy of the natives towards destruction of hopper swarms was a factor that added to the difficulties of obtaining the full amount of crop protection that could have been desired.

So far it seemed that the locust invasion of Nyasaland was to be on a small enough scale to warrant the hope that the country was receiving only the final thrust of a waning locust cycle. The year 1932, however, was not to close without fresh developments. On December 24th, 25th, and 29th large flying swarms of mature red-winged locusts (*Nomadacris septemfasciata*, Serv.) entered the Protectorate from North-Eastern Rhodesia in the vicinity of Fort Manning. The history of this invasion properly belongs to the year 1933, but to make this review complete it may be stated here that, by the end of January 1933, these red-winged locusts had traversed and laid eggs in all districts from Kasungu to Blantyre inclusive, with main concentrations in the Fort Manning and Lilongwe districts, the lake shore areas of the Dowa and Dedza districts and on the line of the Shire river from Fort Johnston southwards. Early in January, also, the Chikwawa and Lower River districts were invaded by mature flying swarms of both species of locusts, with *N. septemfasciata* predominating, from the Zambezi valley and extensive egg-laying took place almost at once. Hope that Nyasaland might remain comparatively free of locusts was thus completely nullified.

Tobacco.

Whitefly (*Aleurodidae, Bemisia* sp.).—The discovery by Dr. H. H. Storey of the Amani Institute that the virus causing the condition known locally as *cabbaging* was transmitted by this insect has given this tobacco disease considerable prominence. The wide distribution of the insect and the very large number and variety of plants on which it breeds render control measures of some difficulty. Although only one weed, a species of *Vernonia* (*fusa*), is definitely known at present to harbour the identical virus, it seems more than likely that others may do so in view of the fact that considerable infection by the disease has been noted in places where *Vernonia* is scarce or even apparently absent. There is no doubt that the greatest assistance to the spread of the disease is given by the presence of undestroyed tobacco plants when harvesting has been completed. As far as observation has been possible, it appears that the insect can continue to breed during the greater part of, if not the whole, year, and wherever old or abandoned tobacco gardens have been examined the presence of diseased plants with whitefly breeding on them has almost invariably been found. Seedbed and field husbandry of the most careful order seem to be essential to any check of the disease. Whether seedbed spraying with nicotine or a similar contact poison as a specific control for whitefly is an economic proposition remains yet to be proved.

It may be pointed out that the removing of diseased plants from the field and allowing them to lie in heaps or singly at the edges of the field does not necessarily bring about the death of the immature stages of the insect that may be present on the leaves. All plants so removed should be buried or burnt, as the larval and pupal forms of the insect are scale-like creatures remaining more or less fixed in one spot on the leaves, and if nearly mature when the plant is uprooted the adult fly will hatch out in spite of the leaves drying up.

Yellow stem-grub (*Dereodus recticollis*, Mshl.).—This beetle larva continues to be a pest of some importance, both in nurseries and in the field. Its subterranean habits render it particularly immune to control measures, and the adult beetle feeds on a large number of different plants and weeds. Open-sited nurseries are less likely to infection by beetles than those with much surrounding vegetation.

Nyerere ants (*Pheidole megacephala*, F.).—A light raking of the seedbed soil after sowing appears to prevent these ants from finding and removing the seed.

Greenfly or aphis (*Myzus persicae*, Sulz.).—During the past few seasons this pest of tobacco has been unusually abundant and the cause of its increase is not at all clear. Although simple sprays of nicotine or tobacco extracts are perfectly efficient in controlling the outbreaks, the use of of such sprays in tobacco fields is nearly always impracticable.

In dealing with tobacco pests in general it has always been apparent that, under local conditions, once the tobacco is in the field little or nothing in the way of economical measures to combat outbreaks of insects can be recommended, unless the particular pest is one that can be dealt with by the primitive method of hand-collecting. Consequently, concentration on the nurseries, the treatments of the plants during their preliminary growth, and scrupulous eradication of all crop refuse both in the nurseries and the field have been the continual urge. There is no doubt that many of the minor ills that sometimes assume serious proportions in the field would be checked if really consistent insecticidal and fungicidal treatment of seedbeds was carried out. The possibility of poor soil condition or infertility being conducive to serious attack by certain pests as well as fungus diseases must always be kept in view and hence circumstances that hamper the planter from carrying out all the field practices he might wish to employ must unfortunately react in favour of the development of the various enemies of the crop.

Tea.

The main piece of work in connection with this crop was carried out in conjunction with the Mycologist, on whom fell the major portion of the study. The subject was the branch or stem canker of the tea bush that had for some years been thought to be caused by a fungus. Satisfactory proof was obtained that the initial cause of this disease was due to the feeding action of the tea mosquito bug (*Helopeltis bergrothi*, Reut.) on the green shoots. An illustrated departmental bulletin (No. 5, New Series) was issued on the subject in December, and it is hoped that a technical paper will be published later elsewhere.

Other observations on tea included two outbreaks of scale insects. In February a heavy infection of *Coccus hesperidum*, L. was found in an area that had been previously badly attacked

by red spider, the soil conditions of this area being decidedly poor. The scale was fairly heavily parasitized at that time and in the course of a few weeks the parasitism was sufficiently high to render the outbreak innocuous.

Various areas were seen in which the scale insect *Aspidiotus rapax*, Comst, had become established on tea bushes, though not assuming serious proportions. In nearly all cases this attack could be correlated with poor soil conditions.

Coffee.

Thrips (*Diarthrothrips coffeae*, Williams.).—An outbreak of this pest occurred on one estate at a most unusual time during March and April before the rains had finished. It was rapidly controlled by a nicotine spray, but the reason for the sudden development of the insect at this time of year was not apparent. Although there was some indication that the soil might be inclined to "pack" at a short distance below the surface, it was doubtful if this was the only contributory factor.

Shade.—In order to test the effect of overhead shade on coffee and its insect enemies a small area (1/10 acre) at the Zomba Experimental Station was covered with artificial slat shading. It is not suggested that such a method could be an economic proposition on any large scale, the total cost for this small area being £2. 9s., but as a demonstration of the benefit of shade under local conditions it promises to give interesting results. As the shade was only erected in November little information is as yet available, but the appearance of the bushes has remained consistently better than those without any shade at all.

On one private estate an attempt is being made to grow coffee under the indigenous forest trees, but this work also is in a very early stage.

Ground covers.—The use of *Indigofera endecaphylla* as a ground cover among coffee has now been employed at the Zomba Experimental Station for over two complete years. Only once has the cover been removed from the bases of the trees and laid down around them as mulch but there has been no apparent ill effect from the cover growing close up to the coffee plants for a considerable length of time, and in fact the plants surrounded with this cover crop have carried through the dry season in much better fashion than those in ordinary weedy land. There has been no development of insects or disease that can be attributable to the use of this cover crop.

White stemborer (*Anthores leuconotus*, Pasc.).—This pest seemed to be abnormally abundant unusually late in the season, and reports were received that small grubs not having yet entered the main stem below ground level were being collected up to the end of July. It is apparent therefore that the emergence of the adult beetles may take place over a rather long period or may be very variable in time. Consequently the absence of the adults early in the season cannot be regarded as an indication that borer infestation will necessarily be slight.

Groundnuts.

Termites.—A bad attack by white ants occurred in a 30-acre field of groundnuts in the Zomba district in March. There was, however, a considerable amount of disease, probably *Rhizoctonia*, in the crop and the general conditions seemed unsuitable for satisfactory growth, the soil being of a light, sandy nature and badly washed.

Rosette disease.—Though not wide spread, a certain amount of this disease can usually be found every year. Although association with any specific insect has not been definitely proved, there can be little doubt that a greenfly, probably *Aphis leguminosae*, Theo., is concerned. Seed of a type of groundnut reported to be resistant to the disease in Gambia was requested from that country.

Fruit Trees.

Psyllidae or leaf-louse (*Trioza merwei*, Pettey.).—Several enquiries were received concerning this insect on citrus trees. The scale-like immature forms of the insect live in small but distinct pits in the leaves and the infection may be so heavy that the foliage on certain branches of the tree has a very striking crumpled and yellow appearance. The insects feed by sucking the cell sap from the leaves. Although probably little serious damage is done on the older leaves, infestation of the younger shoots arrests their growth. A simple soap or nicotine spray is effective in getting rid of the pest for the time being but it will, of course, continually recur and the spraying must be repeated. The spray must be directed to the lower surface of the leaves under fairly strong pressure.

Black fly (*Aphis tavaresi*, Del G.).—This is the common "greenfly" on citrus and other fruit trees, but can be easily and effectively dealt with by spraying with soap, nicotine, or for preference *Katakilla*.

False codling moth (*Argyroploce leucotreta*, Meyr.).—Eggs and young larvae of this moth were taken from tangerines during March and April and considerable destruction of fruit was caused by the pest. Successful control of such an insect requires a considerable amount of organisation and in the case of a few isolated trees in private gardens the trouble is proportionately greater than if a campaign on a large scale had to be undertaken. But careful handling at frequent intervals of the developing fruit in order to remove the minute scale-like eggs which are laid on them might reduce the proportion of "wormy" fruit.

There are many other insects that attack fruit trees in the Protectorate, devouring the leaves, the flowers or the developing fruits, and scale insects of several kinds develop on the stems and shoots. Spraying materials, machines and insecticides, are essential requirements if serious interest is being taken in the cultivation of fruit trees. Such sprays as lime-sulphur for scale insects, nicotine or *Katakilla* for aphis and small caterpillars should always be readily available. And perhaps the most important point of all is that all fallen fruit of all kinds should be frequently and continually collected and buried deeply or otherwise destroyed.

Indigofera.

The use of *Indigofera endecaphylla* as a soil cover among permanent crops is now being more widely adopted and it has been found that certain insects attack the plant, mainly devouring the foliage. Of some importance is a small Chrysomelid beetle, of which both the grubs and the adults feed on the leaves. The beetle is a little under a quarter of an inch long, very rounded in shape and in colour dark blue with reddish margins to the thorax and wing cases. It appears soon after the break of the rains and large numbers of bright yellow, torpedo-shaped eggs are laid on the leaves. The eggs are laid flat, in batches varying in number but averaging 15 and frequently in a herring-bone pattern. These hatch in 7-10 days and the small, blackish, slug-like grubs commence feeding on the leaves. These grubs in all stages are carnivorous and also devour any eggs they may come across. They feed for some four weeks before pupating and the adults emerge some seven days later. Hence the development is rapid and accounts for the large number of grubs and adults to be found in January and February. It was found at the Zomba Experimental Station that the grubs of this beetle, which are sluggish in habit, are heavily preyed upon by the larvae of another beetle, a Carabid or ground-beetle. This beetle is flat, bright blue with a large red-brown spot near the apex of each wing case and its larva is steel blue in colour, very active and feeds on the pest grub by sucking out the internal juices. The adult beetles themselves were not seen to feed on the grubs.

This pest first appeared on the *Indigofera* among the coffee and tea at the Zomba Experimental Station in the season 1930/31. It recurred more severely in the 1931/32 season, when the predatory beetle larva was first noticed. In that season some patches of *Indigofera* were completely defoliated, only the runners being left, nevertheless the crop made a complete recovery and in the season 1932/33 the beetle did not appear at all.

The pest has also appeared at Cholo and Mlanje on *Indigofera* planted on ridge terraces in tea gardens.

If only small patches of the cover crop have to be dealt with the pest can be easily controlled by spraying with lead arsenate, 3 oz.—4 gallons of water, or dusting lead arsenate, on the plants when wet with dew. On the other hand, where the crop is established over considerable areas such a method is impracticable, but from experience at Zomba it seems possible that the pest is only of a transitory nature and the crop will recover.

Two pests that may be of a more serious nature, however, than the above are a very small brown flea beetle (*Halticidae*) and a small leaf-rolling caterpillar (? *Pyralidae*). The former has appeared in large numbers at the same time as the Chrysomelid beetle, and it shotholes the foliage to a serious extent. The caterpillar webs up bunches of leaves and devours them. Although neither of these pests has, as yet, seriously affected the growth of the cover crop, they appear to continue active for a considerably longer time than the Chrysomelid beetle. No information on their life-history has yet been obtained but it is improbable that any of these insects will attack tea or coffee.

Conclusion.

The arrival of locusts in September unfortunately dislocated a good deal of work that was on hand. A certain amount of material in the way of aphids, whitefly and other insects had been collected for despatch to the Imperial Institute of Entomology for identification but the further preparation of it had to be temporarily abandoned together with work on the main insect collection. Lack of accommodation for the collection, museum specimens, for library books and pamphlets is again beginning to make itself felt and the completion of the new agricultural offices is eagerly awaited.

Colin Smee,
Entomologist.

Report of the Mycologist for 1932.

Introduction.

The work on tea yellows was completed. The possibility of a deficiency of sulphur in other crops must be guarded against in Nyasaland. Preliminary experiments are tending to bear this out.

Investigation into the cause of gnarled stem canker of tea was continued in conjunction with the Entomologist. We have found that the primary cause of the disease is the tea mosquito bug feeding on the older green stems of the tea plant. This is of considerable interest as it elucidates a problem which has until recently been connected with attack by fungi such as *Nectria* Spp. and *Macrophoma* sp. and which has never been explained satisfactorily. The control measures for the disease can now be advised on definite grounds.

Some experimental work has been carried out in connection with other diseases.

Tea.

Yellows.—Dr. H. H. Storey of the E. A. Agricultural Research Station, Amani, visited Mlanje in February. During his visit we collected together all our experimental data in connection with this disease. In a paper to the Nyasaland Tea Research Association, Dr. Storey gave a brief account of our results showing that the disease is caused by sulphur deficiency. It is unnecessary to give an account of our experiments here; they have been published in Bulletin No. 3 (New Series) of this department and are to be published in full in *The Annals of Applied Biology.*

As regards the application of fertilizers to combat the disease, the following amounts have been advised as a minimum in order to obtain the desired results with any of the fertililizers mentioned.

	Old plant	Young or supply plant
Ammonium sulphate	1 oz.	... ½ oz.
Potassium sulphate	1 oz.	... ½ oz.
Sulphur	¼ oz.	... ⅛ oz.

Gnarled stem canker.—Previous work on this disease in Nyasaland (Annual Report for 1930) showed that the first stage of the disease appeared "on young green stems as small elongated patches which have the appearance of bruises. The discolouration is at first only slight, but the bruise darkens in colour until it is purplish-brown."

Work this year has been carried out in conjunction with the Entomologist following the discovery of insect punctures in connection with the bruises. We have found that these bruises are the feeding areas of the tea mosquito bug when feeding on the older green stems. Each bruise forms an individual canker, produced by the growth of gall-wood following the collapse of the sucked tissues (pericycle parenchyma and phloem). A number of individual cankers formed close to each other gives the stem its characteristic gnarled appear ance. Fungi play no part in the cause of the disease and are only a secondary factor in the development of the cankers.

Control measures against this disease are dealt with by the Entomologist. Fungi enter the cankers as saprophytes or weak parasites in the later stages of the disease. They are confined to the immediate cankered areas, and as stated in the Annual Report for 1931, "the fact that the canker does not travel down the stem points strongly against the view that any active parasitic organism is connected with the disease." The cutting back of the stems in the nursery has now to be regarded entirely on a physiological basis and not as control measure.

Damping-off disease of seedlings. A serious disease was encountered in some germinating beds of valuable imported seeds. The symptoms of the disease were typical of sore-shin disease of cotton and other plants. The seedling is attacked just above the junction of shoot and root (hypocotyl). A black lesion is formed which rings the stem partially or entirely, usually leading to the death of the young shoots which become black. The young shoot throws off the disease in some cases. The root remains healthy for a considerable time. Some roots which were transplanted gave healthy new shoots from below the dead young stem.

The sand of the germinating beds was matted together with a fine weft of light brown fungus threads and the soil adhered readily to the seedling. The fungus which was isolated from affected seedlings was a species of *Rhizoctonia* closely allied to *R. solani.* It is not known whether the fungus is the causal organism as inoculation experiments have had to be postponed.

Two points of special interest in connection with the appearance of the disease in the germinating beds are (1) some planters allow the seeds to germinate and grow into very small seedlings in the germinating bed prior to planting out in baskets in the field, (2) the sand used in the germinating beds in which the disease was found was poorly washed and contained a high percentage of decaying vegetable matter.

It is unlikely that the fungus was imported on the seed; it was probably introduced into the germinating beds in the vegetable matter which should have been absent. The fungus once established, the high percentage of organic matter facilitated its rapid spread through the sand.

The practice of allowing the seed to germinate to the leaf stage before transplanting rendered the seedling much more prone to attack in the germinating bed.

The disease should not occur if proper attention is paid to the preparation of the germinating bed. The attack was reported too late to carry out experiments with possible methods of control in the affected areas.

Armillaria root disease. An estate, on which this disease has been causing some anxiety in the tea, grew the green manure plant, *Tephrosia candida*, throughout many of the affected gardens. It was not long before the disease was noticed to be killing the green manure plants. The roots of *T. candida* are inclined to become large and woody so it was considered advisable to uproot all of them in order to avoid the risk of the disease spreading more rapidly in the tea by means of the diseased *Tephrosia roots.*

Sulphur Deficiency.

Now that certain Nyasaland soils are known to be deficient in available sulphur there is scope for investigation into the effect of the deficiency on local crops other than tea. Preliminary experiments have been made. It is evident from these that more elaborate experiments may yield some interesting results. Only one experiment is recorded here as the result is of considerable importance to native cultivation on soils which are prone to sulphur deficiency and where fertilizing is unlikely to be employed. *Cowpea* (*Vigna* sp.). Workers in other parts of the world, notably the United States of America, have found that a deficiency of sulphur in the soil may inhibit the formation of nodules on the roots of leguminous plants. The experiment to be described was carried out in the first place to see whether the same result would be obtained on soil growing tea badly diseased with yellows. If this was proved to be so, it would give evidence in favour of the conclusion since reached, namely, that yellows disease is caused by a deficiency of sulphur.

Randomised blocks were treated with nitrophoska and with nitrophoska plus sodium sulphate. Nitrophoska contains nitrogen, potash and phosphorus and only a trace of sulphur. A good stand of plants was obtained in the duplicated blocks and the following results were obtained.

(*a*) No yellow mottling of the leaves (cf. tea) was produced in the plots receiving no sulphate but the leaves were slightly lighter green and had a dull appearance compared to the dark shiny green leaves of the sulphate-treated plants.

(*b*) The sulphate-treated plants had leaflets of greater dimensions than those receiving no sulphate. There was a greater number of leaves per plant in the sulphate-treated plots. All records were taken before the seed pods were formed. As the flowers are produced from the axils of the leaves, a greater number of leaves per plant would indicate a bigger yield of seed per plant.

(*c*) The ratio of "tops" to roots was the same with both treatments.

(*d*) There was no difference in the mean size of nodules on the roots of plants receiving the two treatments.

(*e*) *The number of nodules produced in the sulphate-treated plots was approximately ten times that produced in the no-sulphate plots.*

The results show that *musa* bean plants grown on soil affected with tea yellows and not fertilized with sulphur produced very few nodules. The results indicate that the growing of leguminous green manures on some Nyasaland soils will not be beneficial to the soil unless the sulphur content is maintained, for the following reasons, (i) the amount of green material turned in will be small and (ii) the amount of nitrogen fixed by the plants will be small owing to the reduced number of nodules formed.

The native has methods of rotating his crops; he grows a considerable number of leguminous crops which should tend to keep up the nitrogen content of his soil. The deficiency of sulphur, however, which is likely to occur in his gardens will prevent beneficial results from being obtained by the use of leguminous crops. It is interesting to note that Dr. H. H. Mann in *The Tea Soils of North East India and their Treatment* states on page 74, "I have been informed that a dressing of the soil with sulphur has been found beneficial on these village sites in a few places, and this would favour the theory of infertility having a living origin such as the eelworm."

Chindumba (*Echinochloa frumentacei*).

Smut (*Ustilago? paradoxa X Panici-frumentacei*). An experiment was carried out to test the efficacy of copper sulphate treatment as a control measure against this disease. Seed was steeped in 2½ per cent. and 4 per cent. copper sulphate solution for ten minutes and then dried in the sun. Neither treatment was found to be successful in controlling the disease.

R. Leach,
Mycologist.

Report on the work of the Cotton Experiment Stations, season 1931-32.

Introductory Note and Summary by H. C. Ducker.

The following reports cover the season 1931/32 and to a lesser extent work done in 1930/31. The last previous full report was sent home in 1930.

During 1932 the final decision was taken to concentrate plant breeding and experiment work under the direct control of the Corporation's officers in the Domira Bay area, and the new station is given precedence in this report. Port Herald was finally handed over to the Department of Agriculture on January 1st, 1932, and has become a Government district station. Makwapala, which has been shown to possess certain highly specialised features making it unsuitable as a cotton-breeding station for general purposes, is also to become a district station, and will be handed over to Government after the 1933/34 season.

The Domira Bay station is admirably situated from nearly every point of view. It is close to railhead on the new railway now under construction, and to what is to be the main port of call for the Lake Nyasa steamers. It is approximately half way between Port Herald and Karonga, the most widely separated of the Nyasaland cotton areas, and, to the west, the rich plateau areas of central Angoniland are within easy reach of the station.

Conditions on the station itself are those of summer crop cotton, sown early in the rains; but, within a distance of ten to twelve miles only, are areas where cotton may be sown in the middle of the rains, as a semi-summer crop, and after the end of the rains as a winter crop. The immediate neighbourhood of the station, in addition to providing conditions for experimental work, the results from which may be applied to the whole country, is also admirably adapted to development as a seed multiplication area.

Work at Domira Bay has so far consisted mainly in clearing and equipping the new station, and collecting various seed stocks from the older stations. A beginning has, however, been made in strain testing and variety trials, and a crossing programme is now under way. In addition to the local seed stocks the Station is indebted to Mr. Parnell for a collection of the *U4* types bred at Barberton, and to Dr. Harland for some intesting cottons bred at the Corporation's Research Station in Trinidad.

Work at Makwapala has continued on lines described in previous reports. The yields of cotton obtained in 1932 are noteworthy as being the highest that have so far been recorded from this station.

It has been shown definitely that on the Makwapala type of soil cotton must be sown as an early summer crop, even a strain as adaptable in its requirements as *U4*.

Strain tests with *U4* have proved somewhat inconclusive, but it has been possible to eliminate one of the several strains tried on the ground of insufficient resistance to jassid attack.

Following the success obtained in controlling soil erosion, it seems probable that equal success will be obtained in supplying the second major requirements of the Makwapala soil, namely an easily assimilable organic manure. Results so far are most promising and the method that is being developed is easily applicable by natives in their villages.

Port Herald has been unfortunate in its first year as a district station in receiving another rainfall on the short side for the sandy alluvium of which the soil on the station is typical. Cotton yields are therefore rather low for the third year in succession. Having regard to the fact that the rainfall distribution was better in this past season, it seems probable that the low yield was due to soil conditions and not to the variety sown. At Maperera in the Chikwawa district a strain test similar to that at Port Herald gave yields in excess of 1,000 lbs. seed cotton per acre. The only real difference between the two sites was the heavier and more retentive soil at Maperera.

A beginning has been made with the study of the problems of mixed cropping at Port Herald. It is thought that this practice is preferable to rotation in certain circumstances.

In commercial cotton-growing the issues of the mixed bulk *U4* first made in 1930 are proving most successful, some high yields being reported, especially from the areas of heavier land in the Lower Shire. There is now enough bulk *U4* for the needs of the whole country, and the third wave of relatively pure seed from the stations goes into distribution this year.

While *U4* is proving very, satisfactory as a high-yielding strain adapted to growth under varied conditions in Nyasaland, its lint quality is not too high, and market reports are that it is much harsher than the usual Nyasaland product.

It is to be hoped that the breeding work at Domira Bay will result in either an improved lint from a selection made in the *U4* types, or from a derivative from the crosses that are being made with other cottons.

As an example of the high yielding power of *U4* and its adaptability, it is of interest to note that an observation plot sown at Karonga in 1931 has given the highest yield yet recorded in Nyasaland, the plot in question giving 1,812 lbs. seed cotton per acre.

Staff.—Mr. Hoyle was in charge of the work at Domira Bay for the whole of the period under review; Mr. Miller was similarly in charge at Makwapala. During the absence on leave of the Cotton Specialist, Mr. Miller acted for this officer in addition to his other duties.

Mr. E. Lawrence, now District Agricultural Officer, Lower Shire, was in charge at Port Herald up to June, 1932. He then proceeded on leave and his work was taken over by Mr F. Barker, District Agricultural Officer, Karonga, who was transferred for this purpose.

EUROPEAN AGRICULTURE.

Name of district.	Total acreage under cultivation. acres.	Tobacco. Total. Acres under crop.	Tobacco. Total. Yield cwt.	Tobacco. *Fire-cured.* *Acres under crop.*	Tobacco. *Fire-cured.* *Yield cwt.*	Tobacco. *Flue-cured.* *Acres under crop*	Tobacco. *Flue-cured.* *Yield cwt.*	Tobacco. *Air-cured.* *Acres under crop.*	Tobacco. *Air-cured.* *Yield cwt.*	Tea. Acres under crop.	Tea. Yield cwt.	Coffee. Acres under crop.	Coffee. Yield cwt.
Lower Shire	7,301	...	...	..	...	...	...	...	...	...	..		..
Chikwawa	133	105	439	*13*	*63*	*92*	*376*	...	...	.	..	..	...
Central Shire ...	197	130	440	...	.	*130*	*440*	...	...	...	...	...	..
Cholo	17,257	3,993	14,795	*946*	*4,097*	*2,987*	*10,411*	*60*	*287*	4,178	1,122	389	50
Mlanje	11,938	929	3,293	*318*	*1,199*	*564*	*1,961*	*47*	*133*	8,417	22,985	345	45
Blantyre	6,621	1,333	5,991	*245*	*850*	*1,079*	*5,121*	*8*	*20*	...	...	329	386
Chiradzulu	3,191	720	2,171	*95*	*240*	*610*	*1,888*	*15*	*43*	...	...	...	..
Zomba	3,663	1,400	6,243	*127*	*632*	*1,256*	*5,501*	*17*	*110*	...	...	4	2
Upper Shire	211	102	699	*58*	*290*	...	...	*44*	*409*	...	...	...	...
South Nyasa	1,924	1,353	5,032	*180*	*818*	*1,143*	*4,042*	*30*	*172*	...	...	11	2
Ncheu	2,112	1,522	7,057	*1,137*	*5,595*	*126*	*429*	*259*	*1,033*	...	...	130	141
Dedza	836	275	910	*30*	*70*	*245*	*840*	...	...	...	...	18	18
Fort Manning ...	331	250	961	*185*	*675*	*55*	*261*	*10*	*25*	...	...	2	...
Lilongwe	3,265	1,633	5,764	*1,236*	*4,448*	*172*	*419*	*225*	*897*	.	...	...	...
Dowa	1,292	569	2,029	*485*	*1,718*	..	...	*84*	*311*	...	...	1	2
Kota Kota	10	...	...	...	...	...	...	...		...	...	...	.
Kasungu	22	...	...	...	...	...	...	...	...	...	...	...	.
Mombera ...	1	...	...	...	...	...	...	...	...	...	...	.	.
West Nyasa ...	1,510	...	...	...	.	..	...	...	...	...	.		.
North Nyasa	424	...	...	...	..	...	...	...	...	1	...	220	121
Total ...	62,239	14,314	55,824	*5,056*	*20,695*	*8,459*	*31,689*	*799*	*3,440*	12,596	24,107	1,449	767

NOTE :—TEA : Acreage in plucking 1932 was 7,271. COFFEE : Acreage in bearing 1932 was 531.

EUROPEAN AGRICULTURE—CONTINUED.

Name of district	Sisal. Acres under crop.	Sisal. Yield cwt.	Cotton. Acres under crop.	Cotton. Yield cwt. (lint)	Rubber. Acres under crop.	Rubber. Yield cwt.	Chillies and Capsicums. Acres under crop.	Chillies and Capsicums. Yield cwt.	Maize. Acres under crop.	Maize. Yield cwt.	Wheat. Acres under crop.	Wheat. Yield cwt.
Lower Shire	7,225	500	25	18	...	...	...	...	13	110	...	...
Chikwawa	...	...	10	27	...	...	...	...	15	150	...	...
Central Shire	...	...	...	...	...	...	...	...	...	...	...	..
Cholo	2,560	..	...	...	...	...	...	...	259	3,221	26	77
Mlanje	...	..	..	...	...	...	7	2	195	2,976	1	4
Blantyre	...	...	2	1	...	...	2	4	161	1,624	1	2
Chiradzulu	...	...	16	...	...	...	...	...	53	671	..	...
Zomba	...	...	15	35	...	...	...	...	287	5,340	...	...
Upper Shire	...	...	...	...	...	...	...	...	42	300	...	...
South Nyasa	...	...	...	...	...	...	...	...	...	...	...	...
Ncheu	...	...	135	135	...	...	1	2	48	770	...	...
Dedza	...	...	...	..	...	...	3	13	38	530	18	111
Fort Manning	...	...	...	...	...	...	...	...	11	285	7	76
Lilongwe	...	...	2	2	...	...	...	...	118	1,284	1	...
Dowa	...	...	60	123	...	...	...	...	150	1,693	26	158
Kota Kota	.	...		...	...	...	...	...	3	40	5	30
Kasungu	...	...	...	..	...	...	...	...	10	15	...	...
Mombera	..	...	...	...	...	...	...	...	...	...	...	...
West Nyasa	...	...	...	...	1,500	...	...	...	...	...	...	...
North Nyasa	...	...	...	...	...	...	...	...	41	600	1	10
Total ...	9,785	500	265	341	1,500	...	13	21	1,444	19,609	86	468

EUROPEAN AGRICULTURE—CONTINUED.

Name of district.	Legumes.							Oil Seeds.					
	Total.		*For food.*		*For fodder*		*For green ma'ng.*	Total.		*For crushing.*		*For food.*	
	Acres under crop.	Yield cwt.	*Acres under crop.*	*Yield cwt.*	*Acres under crop.*	*Yield cwt.*	*Acres under crop.*	Acres under crop.	Yield cwt.	*Acres under crop.*	*Yield cwt.*	*Acres under crop.*	*Yield cwt.*
Lower Shire	6	13	*6*	*13*	...	...	...	3	20	...	...	*3*	*20*
Chikwawa	...	...	...	...	...	...	...	...	...	...	...	...	...
Central Shire	...	...	...	...	...	...	...	...	...	...	...	...	...
Cholo	1,269	1,231	*104*	*571*	*33*	*660*	*1,132*	13	10	...	..	*13*	*10*
Mlanje	759	169	*34*	*169*	...	..	*725*	...	...	...	...	...	...
Blantyre	388	543	*51*	*203*	*17*	*340*	*320*	10	5	...	...	*10*	*5*
Chiradzulu	275	170	*9*	*70*	*5*	*100*	*261*	...	...	...	...	...	...
Zomba	451	968	*170*	*918*	*7*	*50*	*274*	33	173	...	...	*33*	*173*
Upper Shire	38	64	*14*	*64*	...	...	*24*	2	11	..	...	*2*	*11*
South Nyasa	152	...	..	...	...	...	*152*	...	..	...	...	..	...
Ncheu	156	40	*4*	*40*	...	..	*152*	1	3	..	...	*1*	*3*
Dedza	276	550	*22*	*550*	...	...	*254*	6	60	.	...	*6*	*60*
Fort Manning	33	150	*15*	*150*	...	...	*18*	...		..	...	...	...
Lilongwe	182	47	*21*	*47*	...	...	*154*	1	1	..		*1*	*1*
Dowa	200	130	*15*	*130*	...	..	*185*	25	151	..	..	*25*	*151*
Kota Kota		...	...	.	..	...	...	...	...	..	..	.	...
Kasungu	..	...	...	...	.	.	..	.	...	...	...	.	...
Mombera	...	..	.	.	.	.	.	...	...	...	...	...	...
West Nyasa	5	60	*5*	*60*	...	...	..	3	20	...	...	*3*	*20*
North Nyasa	9	39	*9*	*39*	...	...		4	40	*4*	*40*	...	...
Total ...	4,199	4,174	*479*	*3,024*	*62*	*1,150*	*3,658*	101	494	*4*	*40*	*97*	*454*

EUROPEAN AGRICULTURE—CONTINUED.

Name of district.	Tung Oil.		Fruit Trees.		Nut-Bearing Trees.		Miscellaneous.		Woodland Artificialy Established
	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres.
Lower Shire	...	...	1	...	...	...	...	...	28
Chikwawa	...	...	...	...	...	...	...	...	3
Central Shire	...	...	...	...	...	...	...	...	67
Cholo	17	...	114	2	1	...	4	22	4,434
Mlanje	13	...	8	...	...	...	...	...	1,264
Blantyre	2	...	12	...	2	...	1	...	4,378
Chiradzulu	...	...	3	3	...	...	30	...	2,094
Zomba	6	...	2	...	...	...	1	12	1,464
Upper Shire	6	...	4	...	...	...	...	...	17
South Nyasa	5	...	4	...	...	...	...	...	399
Ncheu	1	...	5	...	...	...	6	...	107
Dedza	...	...	23	...	9	...	...	...	170
Fort Manning	...	...	5	...	...	...	...	...	23
Lilongwe	1	...	6	35	...	...	5	62	1,316
Dowa	...	...	18	50	...	...	...	...	243
Kota Kota	...	...	2	10	...	...	...	...	...
Kasungu	...	...	2	...	...	...	...	...	10
Mombera	...	...	...	...	...	...	...	...	1
West Nyasa	...	...	2	...	...	...	...	...	...
North Nyasa	...	...	10	...	...	...	1	5	137
Total ...	51	...	221	100	12	...	48	101	16,155

NATIVE AGRICULTURE, 1932.

District.	Seed cotton.	Tobacco		
		Production	Registered number of growers	
			Private estates	Crown land
	Tons.	Tons.		
Lower Shire	1,974	—	—	—
Chikwawa	682	—	—	—
Central Shire	36	—	—	—
Cholo	—	49	510	44
Mlanje	—	352	93	1,953
Blantyre	6	196	338	226
Chiradzulu	—	366	1,531	2,605
Zomba	—	249	2,834	634
Upper Shire	—	30	—	292
South Nyasa	—	—	8	13
Ncheu	—	91	302	719
Dedza	—	348	—	2,582
Fort Manning	—	117	468	865
Lilongwe	—	2,673	2,237	18,186
Dowa	—	1,206	932	11,374
Kota Kota	—	227	—	3,797
Kasungu	—	—	—	501
Mombera	—	—	—	—
West Nyasa	—	—	—	—
North Nyasa	—	—	—	—
Total	2,698	5,904	9,253	43,791

NOTE.—Maize is the staple foodstuff in most districts; groundnuts, rice, wheat, beans and various other crops are also grown by natives for local consumption, but it is impossible to make an accurate estimate of the quantities of any of these crops.

The above tobacco and cotton figures represent the quantities purchased in each district, and do not accurately reflect the production by districts, as many natives grow their tobacco and cotton in one district and sell in another.

NATIVE LIVE STOCK AT 31ST DECEMBER, 1932.

District.	Cattle.	Sheep.	Goats.	Pigs.
Lower Shire	74	1,450	9,452	3,476
Chikwawa	172	1,141	7,643	1,512
Central Shire	716	674	3,539	3,468
Cholo	128	483	2,325	5,180
Mlanje	160	1,202	3,769	1,427
Blantyre	1,157	1,078	5,870	5,694
Chiradzulu	1,379	600	3,456	3,628
Zomba	934	775	1,333	163
Upper Shire	72	3,078	7,339	559
South Nyasa	795	11,060	14,459	103
Ncheu	14,685	4,417	27,160	6,666
Dedza	19,976	17,088	29,767	10,423
Fort Manning	1,150	3,300	8,400	3,900
Lilongwe	19,000	14,500	39,000	4,000
Dowa	19,570	17,520	38,740	14,820
Kota Kota	2,103	2,971	9,695	2,664
Kasungu	3,709	4,398	3,320	8
Mombera	38,037	7,763	15,282	9
West Nyasa ...	3,332	298	1,858	—
North Nyasa	35,627	781	3,128	5
Total	162,776	94,577	235,535	67,705

LIVE STOCK OWNED BY EUROPEANS AT 31ST DECEMBER.

District.	Cows and heifers.	Bulls.	Oxen.	Calves.	Pedigree cattle.	Horses.	Mules.	Donkeys.	Sheep.	Goats.	Pigs
Lower Shire	1,219	23	587	562	2	...	...	...	154	89	86
Chikwawa	196	16	96	180	...	...	...	15	10	...	...
Central Shire	15	3	30	4	...	...	...	2	...	...	4
Cholo	1,372	36	1,159	871	13	1	...	33	266	24	242
Mlanje	1,247	31	930	524	3	...	...	2	195	52	163
Blantyre	1,354	23	1,174	624	29	4	...	16	13	14	185
Chiradzulu	964	19	626	354	12	...	...	7	34	...	30
Zomba	1,093	32	922	366	32	1	...	25	375	22	35
Upper Shire	10	2	3	1	...	...	...	2	23	102	29
South Nyasa	96	7	58	39	...	...	...	...	55	141	4
Ncheu	302	11	203	98	5	...	...	...	78	44	167
Dedza	345	13	310	169	5	...	...	56	317	178	323
Fort Manning	77	2	87	29	...	...	...	14	...	...	8
Lilongwe	207	9	264	86	1	...	...	20	81	27	94
Dowa	80	3	80	47	...	...	...	10	74	2	60
Kota Kota	38	2	12	15	...	...	...	5	99	...	
Kasungu	...	...	...	...	...	...	...	...	7	...	10
Mombera	4	1	6	2	...	...	...	4	...	...	...
West Nyasa	14	2	8	2	..	...	...	...	...	...	...
North Nyasa	209	9	186	106	...	...	...	4	142	11	63
Total ...	8,842	244	6,741	4,079	102	6	...	215	1,923	706	1,507

Annexuxe H

An Analysis of the Cost of the Native Tobacco Board 1932.

RECEIPTS				PAYMENTS			
Balance brought forward from 1931		£9,655 13 8		*Personal Emoluments*			
Revenue 1932				*European Staff*			
Tobacco Tax	£12,978 10 0			Secretary ... £75 0 0			
Sale of tobacco seed to Natives	2,354 1 3			Agent 641 13 4			
Sale of tobacco seed to Europeans ...	59 19 1			Area Supervisors, 2 @ £600 1,150 0 0			
Sale of tobacco leaf ...	138 1 9			Supervisors, 10; 4 @ £500 and 6 @ £360 by £18 to £450 4,298 5 0			
Sale of miscellaneous seeds	12 2 10			Supervisors, temporary, 2 for 2 months @ £25 each per month 100 0 0			
Miscellaneous receipts ...	6 6 11			Temporary Agent, 4 months @ £30 per month ... 120 0 0			
Sale of tobacco booklet ...	7 9 2			Temporary Clerical Assistance 10 13 11			
Interest on fixed deposits	186 17 6			Allowance for Mr. Cormack ... 25 17 4	£6,421 9 7		
Total Revenue ...		15,743 8 6		*Native Staff*			
Advances Returned		143 1 9		20 Clerks, rates and periods variable, £6 to £18 110 5 11			
				242 Capitaos, rates and periods variable, £6 to £18 2,270 6 5			
				11 Watchmen, periods variable, £4 16s. 35 17 9			
				Messengers 19 6	2,417 9 7		
				Total Personal Emoluments		£8,838 19 2	
				Other Charges			
				Travelling	1,490 8 5		
				Passages	333 0 6		
				Seed and Experimental Plots	128 2 5		
				Buildings			
				(*a*) Likuni House, repairs	4 0 0		
				(*b*) Agent's House, repairs	46 14 0		
				Stationery and Printing ...	149 2 11		
				Implements and Equipment	13 15 7		
				Bush Cars	19 13 1		
				Tents	53 0 0		
				Incidentals	23 7 9		
				Uniforms	50 12 4		
				Grain Tanks	94 16 8		
				Tobacco Seed	126 13 4		
				Allowance to Supervisors towards cost of Housing, 7 @ £30 each	210 0 0		
				Fertilizers for native tobacco growers	21 0 4		
				Total Other Charges ...		2,764 7 4	
				Contributions			
				Roads	35 6 0		
				British Empire Producers' Organization	50 0 0		
				Experimental Work, Zomba Station	289 17 11		
				Nyasaland Government— Clerical Assistance ...	112 15 0		
				Total Contributions ...		487 18 11	
				Central Buying Stations			
				Permanent Station Hands	22 6 2		
				Erection and Enlargement of	86 11 4		
				Total Central Buying Stations		108 17 6	
				Total Expenditure ...		12,200 2 11	
				Balance carried forward to 1933			
				Treasury	829 5 9		
				Current account	2,212 8 6		
				Cash on hand	6 9		
				Fixed Deposits	10,300 0 0		
				Total Balance carried forward to 1933		13,342 1 0	
		£25,542 3 11				£25,542 3 11	